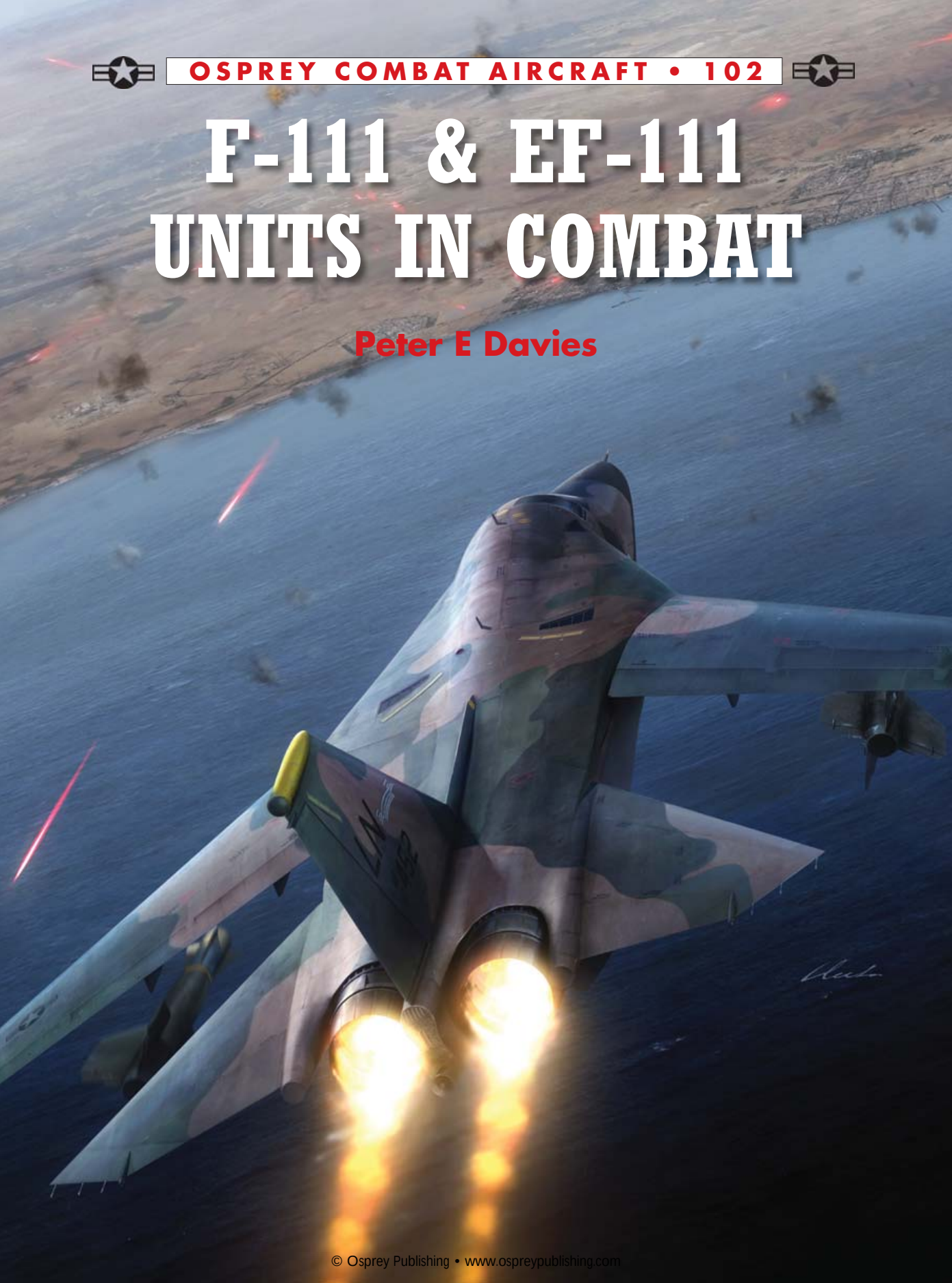

OSPREY COMBAT AIRCRAFT • 102

F-111 & EF-111 UNITS IN COMBAT

Peter E Davies

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SERIES EDITOR: TONY HOLMES

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GENESIS OF A HEAVY HITTER

Operational General Dynamics F-111As entered US Air Force (USAF) service in July 1967 after a difficult development period in which similar versions of the design had been produced, at the insistence of US Secretary of Defence Robert McNamara, as a US Navy fleet defence fighter (F-111B, cancelled during development), a Strategic Air Command bomber (FB-111A) and a tactical fighter-bomber to replace the Republic F-105 Thunderchief. In the latter and most numerous guise it appeared in four sub-variants, one of them remaining in service until December 2010 with the Royal Australian Air Force (RAAF).

The F-111's designers introduced many innovative features for an aircraft that was intended to fulfil such diverse roles, in large numbers, with both the USAF and US Navy. Its variable-sweep wing allowed slow-speed flight for aircraft carrier landings and supersonic, low-altitude operations when swept back. The F-111 effectively became the aircraft that could 'redesign itself in flight'.

For the USAF, a revolutionary automatic terrain-following radar (TFR) enabled the F-111 to fly at a continuous altitude as low as 200 ft above uneven terrain at night and in poor weather – conditions that subsequently became the F-111's natural habitat. The design also pioneered the installation of afterburning turbofan engines, conferring better fuel economy than turbojets for long-range attack missions. For self-protection it had the first integrated electronic countermeasures suite installed in a tactical fighter. It also incorporated, at the US Navy's request, an innovative escape capsule with two-man, side-by-side seating. The capsule floated after an over-water ejection, and crews did not require the cumbersome anti-exposure suits that had to be worn flying other fighters with conventional ejection seats. The capsule also offered much better protection during ejection.

With so much untried technology it was hardly surprising that developmental problems arose. Air intake and engine designs had to be progressively altered to cure engine stalls, several wing pivot boxes failed and the TFR took time to inspire

The first F-111A, 63-9766 demonstrates its revolutionary variable wing-sweep on roll-out at General Dynamics' Fort Worth facility on 16 October 1964. It looks very similar externally to the last F-111, which was not delivered until November 1976. After its maiden flight with General Dynamics test pilots Richard Johnson and Val Prahl in charge, the aircraft flew a further 209 times, reaching Mach 2.3 in August 1965. After retirement in February 1968 63-9766 was put on display at the Air Force Flight Test Center Museum at Edwards AFB, California (*General Dynamics*)

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confidence in pilots who were used to flying an aircraft themselves rather than trusting a computer. However, the difficulties were overcome quite quickly and the F-111's loss rate during development was very low compared with the early Century Series fighters. Some of the initial problems were the result of errors by suppliers of components for the aircraft. However, because of the widespread USAF and US Navy hostility towards being forced to accept a common design that inevitably failed to meet each service's full requirements, the problems were expressed and magnified publicly, and then exaggerated into a long-lasting 'trashing' campaign by the media. It took many years for the very advanced F-111 to be recognised as one of the most versatile and effective aircraft ever produced.

The F-111's early reputation certainly was not enhanced by the aircraft being sent into combat in Vietnam only eight months after its initial delivery, and before any of its USAF acceptance trials had been completed. Three of the eight F-111As deployed to Takhli Royal Thai Air Force Base (RTAFB), Thailand, in March 1968 were lost in unexplained circumstances after only 55 combat missions. Far from proving the aircraft to its critics, this generated even more hostility and threatened the whole programme.

Some of the resistance came from the crews too. The two-man concept was anathema to many former single-seat pilots. Col Bob Pahl, who flew F-111s for 17 years, recalled;

'Former F-105 pilots, many with 100 missions over North Vietnam, didn't like to fly with WSOs [Weapons System Officers] and they would ignore the guy in the right seat as much as possible. Initially, there was a lot of resentment in both the navigator/WSO and pilot communities. They ran out of WSOs so they put PWSOs [pilot/WSOs] in the right seat.'

Some aircrew applied to leave the USAF rather than move from a single-seater to the F-111. Things changed, however, as younger aircrew entered the service and the proportion of senior ranking officers within squadrons declined.

F-111 crews soon realised that auto-TFR could work well, although it required careful monitoring. They had to get used to night descents in mountainous terrain in which an initial ten-degree dive was increased automatically when the TFR picked up ground returns, and continued to dive the aircraft at more than 500 knots until it automatically levelled off at around 1600 ft. Sometimes it was best to trust TFR rather than human judgement. Lt Col Ed Wells recalled a fatal accident at Indian Springs, near Nellis AFB, in October 1975 when F-111A 66-0058, with Capt David Bowles and Maj Don Kenney aboard, ploughed into the side of a hill after a major engine malfunction;

'The crew were making a night bombing run and they were on final approach at 200 ft on auto-TFR when they heard a thump, both fire warning lights came on and then the stick froze. The instructor pilot made a bad decision when he "paddled off" [de-selected] the auto-TFR while he assessed the problem.'

The aircraft struck a 200 ft high mesa (an elevated area of land with a flat top and sides that are usually steep cliffs) some 30 ft from its top, and the subsequent investigation included a search for evidence. 'George Peacock, Operations Officer for the 428th TFS [Tactical Fighter Squadron], took his entire squadron out on the desert a couple of miles back from the mesa', noted Lt Col Ed Wells. 'During their long walk

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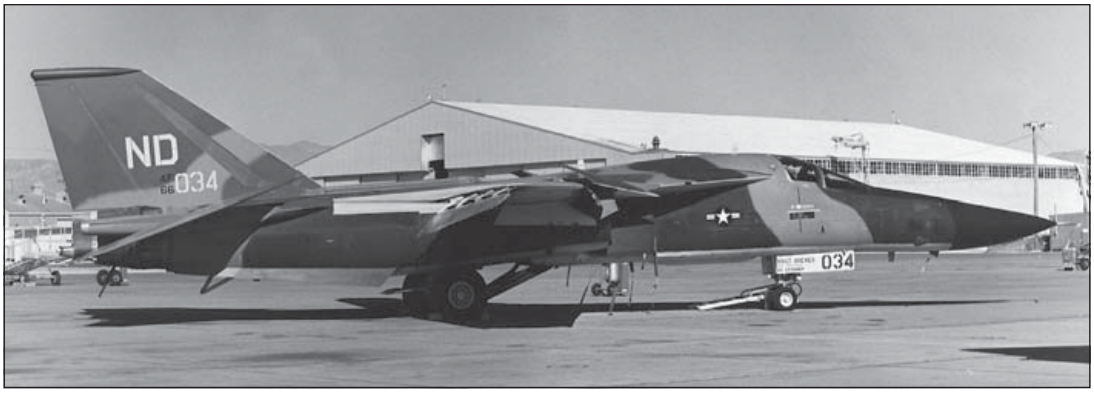

The 452nd CCTS at Nellis AFB trained F-111A crews from January 1968 until the squadron was renumbered the 442nd TFTS in October 1969. It continued to perform the training role until August 1977. This aircraft, still painted in standard Southeast Asian camouflage with FS 36622 Light Gray undersides, was lost at Peach Springs, Arizona, on 6 June 1975 in very similar circumstances to 66-0058 after a turbine blade failure. The pilot on both occasions was Capt David Bowles (*Norman Taylor*)

across the desert in line abreast one of his pilots picked up a fan blade from the first stage of a TF30. It weighed only a pound and was just a foot long. Accident solved again, and "Vark" grounded again for quite some time'. This was the third Nellis loss due to cracked fan blades.

Other aspects of the F-111 were more familiar to those transitioning from other types. Col Bob Brotzman, former commander of the 391st TFS equipped with A-model jets, recalled;

'The Mk 1 avionics in the F-111A and F-111E were basically quite similar to the avionics in the F-4 Phantom II – analogue ballistics and navigation computers with lots of rats busily whirring their respective treadmills. The inertial navigation platform was much more accurate and the attack radar was far superior for ground mapping and target acquisition. The TFR gave the aircraft something the Phantom II never had, but the basic "guts" of the avionics were not much advanced from the F-4 in terms of automating the in-flight experience.'

Real improvements came with the F-111D's digital avionics – described by crews as a 'truly staggering advance' in capability that was not matched until the F-15E Strike Eagle became operational in the early 1990s. Its Doppler radar was 'amazingly accurate' for navigation. The F-111D took several years to become fully serviceable, and elements of its Mk II avionics were incorporated into the F-111F and in upgrades to the F-111E and RAAF F-111C.

However, these advances were still under early development when the F-111A first went to war, flown by the first crews to be trained on the aircraft at Nellis AFB.

F-111A 66-0018 was *Combat Lancer* (Det 1) commander Col Ike Dethman's jet, and it led the deployment to Takhli RTAFB on 15 March 1968. The aircraft also led the det's first combat mission ten days later. Seen here loaded with M117 demolition bombs, the F-111 is also carrying an AN/ALQ-87 ECM pod immediately below the wing glove sweep mechanism. The EB-66 of the 42nd TEWS parked in the background provided essential barrier jamming of enemy radars for the base's 355th TFW F-105 Thunderchiefs. It was unnecessary for F-111A operations, however. This aircraft was converted to EF-111A specification in 1983, flying with the 366th TFW and 27th FW until it had to make a belly-landing and was retired to AMARC in June 1998 (*USAF*)

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VIETNAM

The 4481st TFS of the 4480th Tactical Fighter Wing (TFW) at Nellis AFB sent an advanced team to the 355th TFW at Takhli RTAFB, in Thailand, on 2 October 1967 to prepare for the Project *Combat Lancer* deployment during the F-111A's ongoing operational trials. The team, led by Lt Col Edwin Palmgren (a former *Thunderbirds* pilot), was briefed by F-105F *Wild Weasel* aircrew Capt Al Michael and Maj Jim Mirehouse on their 'Ryan's Raiders'/*Commando Nail* and *Commando Club* night interdiction missions with a small number of F-105F Thunderchiefs, flying solo or in pairs.

This initiative was the USAF response to the US Navy's successful all-weather, night-attack missions by Grumman A-6A Intruders, although the F-105F lacked the Intruder's advanced DIANE (Digital Integrated Attack/Navigation Equipment) avionics. Instead, it relied on 'tweaks' to its R-14 radar system and toss-bombing computer for acceptable accuracy in low-altitude, radar-directed 'blind' bombing. The F-105F attacks used the secret radar installation at Lima Site 85 on a cliff top at Phou Pha Ti, in northern Laos, which had provided tactical air navigation (TACAN) references for missions right up to the Hanoi area since late 1967. This site was overrun by North Vietnamese troops on 11 March 1968, with consequent damage to the US radar-bombing effort that was partially remedied by the rapid arrival of F-111As at Takhli just six days later.

Lt Col Palmgren, who became *Combat Lancer's* Operations Officer, established that the F-111A trials team, comprising 49 officers and 298 airmen, would be self-sufficient within the 355th TFW. The original in-theatre arrival date – 1 February 1968 – was subsequently delayed by six weeks. The first production F-111A (66-0013) for Col Chester van Etten's 4480th TFW had only been delivered to the USAF on 24 September 1967. The jet was flown to Nellis by Col Ivan 'Ike' Dethman, the 48-year-old World War 2 veteran commander of the training unit that would generate *Combat Lancer* personnel. Unusually, the flight got some positive publicity for the F-111A when Col Dethman revealed that he had made the entire 1000-mile trip from General Dynamics' Fort Worth plant on auto-TFR at 500 ft.

At Nellis, the training (Project *Combat Trident*) progressed rapidly using seven F-111 Flight Test Force instructors who had conducted pre-production testing on the aircraft at Edwards AFB, in California. Daylight training to gain confidence in the jet was quickly followed by exclusively night-time, combat-related flying. Twenty-two pilots (many with F-100 or F-105 combat experience) were assigned to the first F-111 squadron, including nine who were qualified F-4 Phantom II front-seaters. To their chagrin many were assigned to right-hand seats as 'pilot-navigators' in the F-111A, and therefore (unsuccessfully) applied for resignation from the USAF. In the opinion of Col Bob Brotzman, who commanded the 391st TFS with F-111As;

'The younger pilots chafed at being in the right seat – they weren't trained for it and their pilot skills atrophied while they were there. This set

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the aircraft back several years, and quite possibly caused a few of the peacetime and combat losses.'

Combat Lancer right-seater Col Rick Matteis, a former F-4E Phantom II commander, was among those disappointed to be selected for the F-111A;

'We perceived ourselves as having been downgraded from aircraft commanders in the F-4 to "pilots" in the F-111. The Air Force wanted nothing but pilots in the early crew force so that either crew member could fly the aircraft and bring it back for landing in case of emergency.'

After 1969 the crew members were renamed 'aircraft commander' (AC) and 'weapons systems officer' (WSO, or 'Wizzo'), and they arrived from separate specialist training courses. For *Combat Lancer*, however, both crewmen were known as pilots in an 'integrated crew'. The 4481st TFS flew around 40 hours per month, which was twice the normal sortie rate for aircrew at Nellis, using pre-production F-111As due to the shortage of new production models. Their priorities were learning to monitor their TFR closely and pounding the Nellis bombing ranges. Even so, by the time of their deployment crews still had less than 100 hours on the F-111.

The aircraft were prepared for combat under Project *Harvest Reaper*, which saw their defensive electronic warfare systems (DEWS) and avionics installations modified and the jets' undersides painted (as former *Combat Lancer* maintainer Marvin Reyes noted) in FS 34102 Green over the factory-finished FS 36622 Grey to reduce visibility at night. The M61 gun module was installed in the weapons bay but not used for the 1968 deployment. According to Lt Col Jack Funke (who spent 12 years assigned to the F-111, and who flew 129 combat missions from Takhli in it), 'The gun was never used in training or in combat from 1972 through to 1986, either at Nellis, Mountain Home or in Southeast Asia'. It was, however, retained in F-111Ds until 1981. There were long delays in clearing the gun for use, as Col Larry Peters recalls;

'The OT&E [Operational Test and Evaluation] for the gun and missile was put on hold because of a bad mishap during the acceptance test at Edwards AFB. A crew shot themselves down while testing the gun, whose port had a heavy 'anvil' mechanism that was designed to rotate and expose the gun barrels once the trigger was squeezed. It didn't rotate and the gun fired anyway.'

On arrival at Takhli the *Combat Lancer* F-111As were surrounded by heavy security while 355th TFW commander, Col John 'Big Kahuna' Giraudo, welcomed what he assumed would be the first of the replacements for his tired F-105 Thunderchief force (*USAF*)

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A *Combat Lancer* F-111A with 12 M117 bombs – twice the typical load for one of Takhli's F-105Ds. A manually-released entrance ladder and step were initially installed in the nose areas of F-111A/C/E and FB-111A models, but they were later deactivated in favour of ground equipment items, as seen here (*USAF*)

A *Combat Lancer* night sortie in preparation as MSgt Kelley looks over this smart-looking F-111A's Form 781 and Sgt Chattman undertakes the unpleasant task of refilling the liquid oxygen reservoir. Dark patches on the nose indicate the presence of the AN/APS-109 RHAW system. They were usually painted over after the late 1960s. In the opinion of Lt Col Bill Baker, '*Combat Lancer* failed because the F-111A had not even completed operational evaluation when the decision was made to send the aircraft to Southeast Asia' (*Bill Lassiter via Mike Kaplan*)

Uniquely, the left side of the weapons bay in *Combat Lancer* F-111As also contained an AIM-9B Sidewinder mounted on an extending, two-missile 'trapeze' launcher.

Harvest Reaper also provided purpose-built McDonnell Douglas BRU-3A/A bomb racks that were aerodynamically streamlined to reduce drag and vibration. Originally designated the MER-100 for possible use on the F-4 Phantom II, the rack received electrical modifications in 1967 that resulted in it being re-designated the MER-102 or BRU-3A/A for the F-111. It dispensed with the usual sway braces for multiple racks, bombs now being ratcheted tightly against T-shaped suspension lugs in an effort to improve ordnance security in flight. For *Combat Lancer*, BRU-3A/As usually held six M117 GP bombs with MAU-91 high-drag fins (or M131 conical fins for high-altitude drops). Four 2000-lb Mk 84s with conical fins were uploaded directly to pylons for at least one high-altitude drop, and M118 3000-lb weapons were also used.

Despite these significant upgrades, *Harvest Reaper* did not fully standardise the aircraft according to Lt Col Bill Baker;

'Several of the airframes still had a panel for varying the flight control inputs – solely a test function. Weapons testing had not been performed with the new jets, so aircrew never knew what would come off the racks at weapons release. Several times the racks released, complete with a cluster of six Mk 82s!'

On 15 March 1968 the six F-111As (66-0017, -0018, -0019, -0020 -0021 and -0022) of Det 1, 428th TFS, formed from the 4481st TFS on 20 January 1968 when the 4480th TFW became the 474th TFW 'Roadrunners', took off on the 7000-mile, 20-hour transit to Takhli, stopping only once at Andersen AFB, Guam, for an 18-hour break. Several crews had to be assisted out of their jets at Guam after 13.5 hours strapped in the cockpit. 'Ike' Dethman put F-111A 66-0018's big wheels onto Takhli's runway on 17 March, and minutes later he was garlanded by a Thai beauty as he got out of his aircraft. The detachment was then welcomed by numerous dignitaries, including Gen Jack Ryan, commanding the Pacific Air Forces, and Lt Gen Joseph H Moore, the USAF's Inspector General.

Col Dethman told the assembled press that the deployment was there 'for a mission, not for a test', but all the crews knew that much was expected of them. They had eight days to acclimatise and to find suitable accommodation to try and sleep during the day while the co-located Thunderchiefs roared off on missions.

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Gen William Momyer, Seventh Air Force commander from July 1966, saw the F-111A's capability as a 'revolutionary breakthrough in an all-weather delivery system' and planned to use the aircraft within the 30-mile circle around Hanoi. Their arrival was greeted with less enthusiasm by the overworked Takhli F-105 pilots, who tended to flip their refuelling probes in sarcastic gestures as they taxied past the 'Flying Edsels' (a reference to one of Robert McNamara's unsuccessful motor industry projects).

Combat Lancer **pilot-navigator Rick Matteis in 'speed jeans' with his F-111A at Takhli. Crewed with Col 'Ike' Dethman, he flew the first F-111 combat mission on 25 March 1968 (*Tom Germscheid*)**

Like most wartime newcomers, the detachment's first mission was flown in the relatively low threat area of Route Pack 1. Col Dethman and Capt Rick Matteis flew a *Commando Nail* mission in 66-0018, dropping 12 M117 bombs on an arms dump on Tiger Island (Hon Co) on 25 March. Three more single-aircraft sorties were flown that night, including one by Lt Col Palmgren's crew, flying through heavy overcast at low altitude. He commented, 'I think the only time they knew we were there was when the bombs went off'. The North Vietnamese and Laotian nickname for the F-111, 'Whispering Death', was born.

The Route Pack 1 missions took the F-111As over Nakhon Phanom, near the Thai border, across the Mu Gia Pass and into the Dong Hoi area at 500 ft TFR altitude, returning over the Gulf of Tonkin. On 31 March President Lyndon Johnson announced a 'pause' in bombing around Hanoi and Haiphong while the *Combat Lancer* crews were still working towards hitting those far more heavily defended targets.

The loss of 'Omaha 77' (66-0022), with Maj Harry McCann and Capt Dennis Graham aboard, on 28 March was unlikely to have been caused by enemy fire (despite North Vietnamese claims) since their mission traversed a fairly lightly defended area to bomb another suspected truck park at Chao Hao. However, the crew were probably flying at an altitude above the usual TFR settings, so this possibility remains. Missions were flown in radio silence, and Col Tom Germscheid, performing a mission 15 minutes ahead of 'Omaha 77' and using the same radio channel, heard nothing from McCann's crew.

Radar contact with 66-0022 was lost, and it appears to have turned back for 140 miles into Thailand at around 8000 ft, having flown a figure-of-eight pattern on the Thai border while attempting to contact the 'Cricket' airborne command post for permission to enter North Vietnam. The jet then flew into a heavy storm, before disappearing from the screens. It was conjectured that the aircraft struck a karst slope while out of TFR mode, although Rick Matteis theorised that it was hit by anti-aircraft artillery (AAA) while orbiting near the border.

After receiving *Harvest Reaper* combat-ready updates, F-111A 66-0022 joined the *Combat Lancer* deployment to Takhli RTAFB. Just three days after its arrival the jet became the first F-111 in-theatre loss when it flew into heavy rainstorms and crashed in the Phu Phan mountains of northern Thailand. killing Maj Henry McCann and Capt Dennis Graham (*USAF*)

The second loss, on 30 March, occurred at around 10,000 ft over Thailand en route to a target, and the crew, Maj Alexander 'Sandy' Marquardt and Capt Joe Hodges,

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The F-111A's ability to fly lengthy missions with heavy bomb-loads like this complement of Mk 82 LDGPs, no external fuel tanks and no supporting tankers, escort fighters or ECM aircraft set it apart from all other USAF tactical strikers in the Southeast Asia theatre. Its integrated electronic warfare suite included a Sanders AN/ALQ-94 deception jammer to 'fake out' enemy radars, a General Dynamics ALE-28 dispenser for chaff and flares and a Dalmo-Victor AN/APS-109 radar homing and warning system in the nose, wing glove area and elevons. This gave the crew audible and visual warning of any hostile radar emissions from fighters, AAA emplacements or SAM sites. It worked together with a Cincinnati Electronics AN/AAR-34 infra-red receiver located in the rear of the tail-fin cap, warning of infra-red emissions from missiles or fighters to the rear of the aircraft (*Sgt Jesus Garcia/USAF*)

successfully used 66-0017's escape module. The aircraft ('Hotrod 76') pitched up violently after structural failure of a valve in the stabilator control system as the crew descended towards Laos. It entered an uncontrollable roll, obliging the crew to eject before their F-111A crashed inverted. They were recovered by an HH-3E rescue helicopter flown by Maj Wayne Oldermann after mistakenly assuming that they had landed in Laos and trying to hide in the jungle to avoid enemy fire, which was actually their own 20 mm ammunition exploding.

Examination of the wreckage indicated that the valve had failed due to a poorly welded joint. Operations were briefly suspended for this investigation and intense press criticism followed, but once the F-111s returned to combat the detachment flew two faultless missions each night against arms dumps, truck parks and supply caches in Route Pack 1 for 22 days running. Often, these targets were just map coordinates based on sensor data from RF-4C reconnaissance aircraft. F-111A 66-0016 arrived from Nellis on 1 April, followed by two more replacement jets (66-0024 and -0025) on 5 April. One of the latter machines was flown by Lt Col Ben Murph, commander of the 428th TFS, who was tasked with taking over the detachment. This left the strong impression amongst surviving F-111 crews that 'Ike' Dethman had been made the scapegoat for the two losses.

The US media, uninterested in the many successful sorties by what they called the 'suicide F-111', went into overdrive after the third crash on 22 April, generating more scare stories about the jet's technology being handed to the Russians. Korean War veteran Lt Col Palmgren and US Navy exchange pilot Lt Cdr David 'Spade' Cooley flew 66-0024 as 'Tailbone 78' against a truck convoy that night. As they descended for a bomb run at around 200 ft contact was lost and no trace of the aircraft or its crew was ever found.

There was speculation that another tail actuator failure was responsible, while others attributed it to Ed Palmgren's preference for using manual TFR to fly lower than the 200-ft auto-TFR limit. The former theory was strengthened by the loss of another aircraft near Nellis on 8 May, F-111A 66-0032 suffering the same fate as Marquardt and Hodges' aircraft on only its 13th flight due to a faulty tail actuator. Similar faults were found in 42 other F-111As, and it was assumed that a fractured electron beam welding had allowed the elevator servo actuator to become unscrewed, forcing the elevator into the 'full up' position and throwing the aircraft out of control.

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A more public mishap was to occur on 22 December 1969 when 'Roadrunners' F-111A 67-0049 sustained a wing-bearing failure while pulling out of a rocket-firing dive at the Indian Springs range in Nevada. The fleet's wing carry-through boxes (WCTBs), including 67-0049's, had been reinforced with steel gusset plates after fatigue cracks were discovered around bolt holes near the wing pivot, but despite this the right wing had still broken off. The crew immediately ejected, but the aircraft was rolling rapidly and it crashed inverted before the module activated fully, killing both men.

Intensive tests of all airframes followed the discovery of impurities in the metal of 67-0049's WCTB, and General Dynamics constructed cold proof testing facilities in Waco, Fort Worth and Sacramento, where the F-111s' wings were flexed by powerful rams at -40°F – the best way to test the integrity of the metal components. Only three more failures, including a tailplane spigot, occurred and the aircraft was cleared for continued service. Cold-proof tests subsequently became a regularly scheduled and costly part of the F-111's maintenance cycle throughout its service life.

At Takhli in May 1968 the five surviving F-111As were grounded until 21 June, and then initially restricted to training flights within Thailand. Later combat missions were conducted against easier Route Pack 1 targets, however, with an F-105F occasionally 'riding shotgun' for the lone F-111. In the wake of these crashes the detachment lost its independent status within the 355th TFW, the wing duly supervising 're-training' (including check rides in F-105Fs) for the surviving F-111 crews. The eight-month deployment ended on 19 November when Lt Col Murph led the five F-111As back to Nellis AFB, having validated the aircraft's unique abilities in combat by successfully flying 60 per cent of its missions in bad weather. As Tom Germscheid recalled, 'We didn't bring the war to a quick end, but we achieved many other accomplishments. We proved the low-level,

Two of the five *Combat Lancer* survivors head back to the USA in November 1968. Late in the deployment the jets had crew names stencilled in black under their cockpits. On the tanker is the commander's aircraft, 66-0018, with the names of Lt Col Ben Murph (left side) and 'Flying Dutchman', the nickname of Capt Fred de Jong, Murph's WSO, on the right. In the foreground is 66-0016 with Lt Col Dean Salmeier's name on the right side. Its assigned pilot was Maj Charlie Arnet (*Tom Germscheid*)

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night, adverse weather, long range – the jet didn't need tankers – interdiction capabilities of the F-111A'.

In Lt Col Bill Baker's opinion, the losses were partly due to 'poor training in adverse weather prior to combat. All training routes in the USA were VFR [visual flight rules] only, so aircrew had no idea of what attenuation due to heavy rain looked like on the attack radar or TFR'. While weather in the monsoon season was a major difficulty for early 'Aardvark' crews, many subsequent pilots and WSOs were actually used to worse conditions flying with USAFE, as Col Bob Pahl explained;

'When I went to Vietnam there was a bit of a load taken off because the weather was such an issue in Europe. Okay, you got shot at in Southeast Asia, but in Europe I was more worried about the heinous violation of getting close to a "Purple" airway, or having people point a finger at you for getting close to another aeroplane or London Mil!'

The *Lancers'* other main problem was in identifying targets early enough to allow WSOs to bomb effectively at such high speeds and low altitudes. Only 18 of the 71 sorties flown could demonstrate very satisfactory results, and less than half the ordnance fell within 500 ft of the target – a slight improvement on the US Navy's average A-6A Intruder scores in poor visibility. The F-111s were not, in any case, expected to cause destruction of strategic targets. Their value on solo night missions was to show that they could strike anywhere, in any weather, without warning. With relatively few sorties, they could sustain harassment of enemy forces, undermining morale but also hitting important targets, while the enemy defences were unable to stop them. Although flying at low altitudes to avoid surface-to-air missiles (SAMs) was to account for 70 per cent of the 2300 American aircraft lost in Vietnam, it worked well for the F-111 crews.

CONSTANT GUARD V

Although the *Combat Lancer* experience had not improved the F-111's public image, it impressed many within the USAF who understood what had actually been achieved, including Gen John D Ryan. He had supported the aircraft as a more accurate successor to his F-105F 'Ryan's Raiders', although he regretted the too-hasty *Combat Lancer* deployment. And it was Ryan who subsequently advised Seventh Air Force commander Gen John W Vogt to reintroduce the F-111As of the 474th TFW to combat in Vietnam in 1972.

Vogt had been tasked by President Richard Nixon with making more aggressive use of US air power against a perception in Washington, D.C. that the USAF could not cope with the Southeast Asian climate – the latter was forcing too many missions to be cancelled when Nixon wanted to increase pressure on North Vietnam through Operation *Linebacker*. Part of the solution was the use of 'weather-proof' Boeing B-52s in high-altitude radar-bombing missions above the 20th parallel for the first time. The introduction of laser-guided bombs (LGBs) for F-4 Phantom IIs, using the six AN/AVQ-10 PAVE Knife TV/laser designator pods that were available in mid-1972, also increased the efficiency of bombing missions, but they required good target visibility, as did TV-guided bombs.

Generally, radar targeting during the Vietnam War could only place bombs within 100 ft of the target, while the first Paveway I LGBs, targeted via PAVE

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Knife pods, were accurate to within a few feet but limited to daylight use. Tactical Air Command (TAC) had estimated that F-111As would average around 200 ft accuracy (although much better scores were often achieved) day or night, in all weather conditions.

Although the F-111A had no laser targeting capability, Vogt thought that its accuracy with 'dumb' bombs would make the jet a suitable candidate for attacking most of the larger targets that were likely to emerge in the renewed bombing campaign against North Vietnam. It had demonstrated better accuracy in this respect than the B-52, and it could fly into heavily defended North Vietnamese airspace without support from tankers or escort aircraft. Ryan proposed deploying 48 F-111As from the 474th TFW's 429th and 430th TFSs to Takhli in *Linebacker Sherry*, but only as replacements for a commensurate number of Takhli's 49th and 366th TFW F-4 Phantom IIs. This happened, despite Vogt's objections, and he also removed 45 KC-135A tankers from Bangkok Airport in accordance with Thai government demands, as the F-111As only required tankers in emergencies.

A 'Roadrunners' crew with their full load of Mk 82 'slick' bombs on the F-111A's specially designed BRU-3A/A bomb racks. Bomb-release sequence was lower aft, lower front, left aft, left front, right aft, right front. BRUs could be hung on all four swivel pylons, and this was done for some *Combat Sky Spot* missions but not operationally thereafter. No bombs apart from Mk 82s could be loaded on the inboard sides of BRUs (Stations 4/5). Partial loads could be in 'slant' configuration (lower and outboard racks) or 'flat' (inboard and outboard) (*USAF*)

The selection of the 474th TFW for the deployment surprised many at Mountain Home AFB, including Lt Col Bill Baker;

'When the decision was made to send the F-111A into combat in 1972 I was at Mountain Home AFB with the 347th TFW, and we had just passed our operational evaluation inspection. We naturally thought that TAC would use our more capable F-111F models for the deployment. It became obvious that Nellis AFB [474th TFW] had been overstating its Combat Readiness Status ['C Status'], and could only flesh out two squadrons for the deployment – the 429th and 430th TFSs. TAC went out to Cannon and Mountain Home in search of volunteers to augment the 428th TFS, thus avoiding the need for a forced assignment of crews to this unit.'

Col Larry Peters had flown F-111Fs with the 391st TFS/347th TFW prior to returning to Thailand in F-111As;

'We were all volunteers on *Constant Guard V*. All the left-seaters had had a previous combat tour, and we all felt it would be just a matter of time before we were called back for a second tour anyway. The transition back to the A-model was really a piece of cake to us. We called it a downgrade check-out, but it was actually more demanding for the right-seaters because of the differences in the avionics. The F-model was really the best of all the F-111s, with avionics that fixed all the shortcomings in the Mark 1 systems. For example, in the Mark 1 TFR, the bank angle for a turn was very limited [15 degrees compared with 30 degrees for later models], making low flying a real challenge.'

Forty years after the deployment, Brad Insley, the high-time F-111 pilot with 5056.9 hours on the jet, reflected on *Constant Guard V*;

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'The squadrons at Nellis were all below strength, and they consolidated the mission-ready crews into the 429th and 430th TFSs. Then they took the training classes that were furthest advanced and fast-tracked their checkouts to fill up those squadrons. The rest of the crews were transferred to the 428th to be checked out, and some of them became our first replacement crews. The young crews flew the aircraft to Thailand because TAC required 100 hours in the jet before you could fly combat, so I got to fly over. About a third of the WSOs were pilot-WSOs (PWSOs), as there weren't enough navigators available to fill the slots.'

The deployment began when 12 yellow fin-flashed 429th TFS F-111As were flown by 442nd Tactical Fighter Training Squadron (TFTS) ferry crews to Guam, where they were picked up by 429th TFS personnel, who completed the 11-hour flight to Takhli on 28 September 1972. They overlapped with the 8th TFS/49th TFW, whose 18 F-4Ds were preparing to return to the USA after five months of combat. As Brad Insley reflected ruefully, 'I found out that you don't want to drink a six-pack of Coke on an 11-hour flight'. The second tranche of 12 429th TFS F-111As arrived two days later, but the 430th TFS's 24 F-111As (red fin flashes) had to wait at Clark AB in the Philippines because the other departing F-4 squadron (9th TFS) was delayed for four days by a typhoon.

Both 474th TFW squadrons were in place by 4 October, with their support equipment arriving in 40 transport aircraft. Some of the wing's Advanced Echelon (ADVON) mission-planning staff were also delayed, but resident 366th TFW personnel helped with target information, providing mission folders for six targets by the time the F-111As arrived. Later missions used a bank of imagery from the F-111As' own radarscope cameras. The aircraft had flown from Nellis with their BRU-3A/As in position to save time in mission preparation.

Late on 28 September crews who had flown directly to Takhli manned the first mission against targets in Route Pack 5 within 33 hours of the first F-111As leaving Nellis AFB, and just four hours after their arrival in Thailand.

Tactics, reinforced by visiting US Navy A-6 crews, required low-altitude strikes using similar profiles to *Combat Lancer's* – target approach speeds of 480 knots and weapons delivery at around 500 ft, rather than the high-altitude area orientation drops over Laos that had been anticipated. Crews chose their own routes, navigating around known radar and air defence locations and attempting to 'deconflict' with the turn and crossing points chosen by other crews. After each mission the crews' flight plans were usually destroyed to increase security, as many plans used similar routes around the relatively limited target areas.

The F-111A's jamming power was provided by General Electric AN/ALQ-87 external noise-jamming pods, hung from the left weapons bay door area and under the rear fuselage. This unit was used by many tactical aircraft, including this *Combat Lancer* F-111A, to jam SA-2 'Dvina' command guidance signals (*Tom Germscheid*)

Unlike the *Combat Lancer* crews, the participants in the new deployment felt well prepared for battle. In Col Roger Mathiasen's opinion, 'We were extremely well-trained and knowledgeable, ready for combat. We knew the environment we were heading to would hold more challenges, and it did'. Many of those

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challenges derived from the differences between the mountainous topography of the squadron's Nevada training ranges and the forested karst landscape of Laos and Vietnam.

The extra demands of low-altitude terrain-following radar flying required constant checking of the TFR scope, low altitude radar altimeter (LARA) and the steering commands displayed on the horizontal situation indicator (HSI), in addition to the normal instrument checks, while simultaneously locating a series of turn points without visual references outside the cockpit and avoiding enemy threats. To many pilots this all seemed basically unnatural. Usually, the WSO had his head in a long rubber cone (or 'feedbag') attached to the radar scope which improved the quality of his imagery, but also denied it to the pilot's eyes. He reported to the pilot on the ground returns received on the scope, which the pilot could compare with the imagery displayed on the E-scope situated on the centre instrument panel closer to his viewpoint. The TFR gave a series of aural tones, with a high pitch to indicate that it was commanding the flight controls to climb automatically above upcoming terrain and a deeper tone to mark that a dive to lower altitude had been commanded.

Six aircraft were armed and prepared for the 28 September missions, but three withdrew with pre-takeoff systems faults according to the stringent go/no go rules observed in-theatre. A fourth jet returned to base when one of its AN/ALQ-87 ECM pods failed. This full-systems ECM requirement was ironic for the equipment was frequently switched off during missions, although the internal systems managed well against radar-directed AAA. As *Constant Guard* veteran Lt Col Tony Sobol remarked, 'Our biggest threat was hitting the ground, and then came AAA. Generally we didn't give a shit about ECM. Going low level was good enough'. Additional hazards came from parachute flares suspended ahead of the F-111As' flightpaths, these being employed both to illuminate the jets for the gunners and disorientate the pilots. Finally, chaff rockets, fired as the aircraft approached, could make TFRs 'see' the resulting chaff cloud as an obstacle, signal a 'fly-up' and place the F-111A at a suitable height for AAA gunners.

Only one aircraft managed to bomb a target and return on that first night, although pilot Capt Bob Sponeybarger was forced to drop on his secondary target rather than the main objective. Capt Brad Insley was still en route to Thailand at Hickam AFB when some unwelcome news broke. 'We heard that we had lost a crew. The two crews that did return said that they had almost hit the ground when their TFRs blanked out flying into a rain storm'. This was a regular problem for F-111 crews, particularly as the deployment began at the start of the monsoon season.

The search and rescue (SAR) effort for the crew of 67-0078 'Ranger 23' (Maj 'Wild Bill' Coltman and 1Lt Robert 'Lefty' Brett) covered 8400 square miles of Laotian and North Vietnamese territory, but nothing was known of their fate until a Joint Task Force for Full Accounting team discovered their remains in northern Laos in 1998. The security benefits of restricting exact details of intended routes to the crews themselves had to be weighed against the difficulty in mounting a SAR effort, or even locating the crash, particularly when aircraft went down without time to activate distress signals or even eject the escape module. This was true of the majority of Vietnam F-111A casualties.

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Combat operations were suspended for a week of practice TFR flying in Thailand and some area orientation that had been missed in the politically-motivated desire to begin flying combat in record time after arrival on base. Brad Insley, delayed at Clark AB, 'flew high-altitude missions until we had flown a day sortie to see the effect of rain showers on the TFR and attack radar', but once established at Takhli, 'when we started flying low-level again we were mostly attacking worthless targets, which was frustrating. Eventually, we started getting more important targets, but the restrictions were annoying. We targeted a supply depot at Bat Lake in Route Pack 1 one night with a restricted attack heading to ensure that we didn't hit the dam that was beside the depot. Upon our return to base, we were escorted by security police who had orders to arrest us if our mission film showed that we had indeed aimed at the dam. Once our film was reviewed, showing the depot being bombed, we were free to go'.

A change in tactics set minimum safe TFR altitudes to 1000 ft above the highest terrain in mountainous areas within five miles of the planned flightpath. Over smoother terrain a 500-ft set-clearance plane (SCP), dubbed the 'weather mode', could be set. All TFRs had to be checked at a set altitude soon after takeoff to ensure a 'full systems' mission. A fault in any of the aircrafts' systems prior to takeoff or early in the flight meant an aborted sortie and relief from one of the four armed spares that were usually on call.

Following this initial loss on 28 September all surviving jets were thoroughly examined and missions resumed with medium-altitude drops in Route Pack 1, building up to around 23 sorties per night from 13 October. The latter included flights by the most experienced crews into the high-threat Route Pack 6, for which fully operational systems were always required.

A further problem facing the mission planners was the lack of accurate maps to plot terrain features as radar predictions on the crews' route charts. This inadequacy, coupled with the very brief time that WSOs had at high-speed and low altitude to recognise their radar aim points or targets and place the bombing radar crosshairs on them reduced the accuracy of some sorties and certainly added to the pressures on crew members. Greater use of radarscope photography from the base's ES-85 Mobile Film Processing Facility was one way of improving accuracy.

A second reappraisal of tactics followed the loss of the 429th TFS's 'Coach 33' (67-0066) on the night of 16 October. Once again the possibilities of an SA-2 SAM hit while the aircraft climbed above 1000 ft to drop its four Mk 84s, or shrapnel damage by those low-drag bombs, were raised, but there was no explanation for the loss of Capt James Hockridge and 1Lt Allen Graham when their aircraft was destroyed close to its Dai Loi railway bridge target near Phuc Yen airfield.

North Vietnamese claims to have shot it down were lent a little credibility by the fact that it was the only occasion on which enemy defences claimed an F-111A shoot-down *before* such a loss was announced by the US command. They also produced images of F-111 wreckage. There were five SAM and numerous AAA sites within lethal range of 'Coach 33's' track. Other crews thought it more likely that Capt Hockridge was performing an evasive manoeuvre and became distracted at low altitude just before weapons release.

After this incident the use of 2000-lb Mk 84s was prohibited for most missions, particularly in heavily defended areas where an F-111A would

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have to climb to a 1000-ft drop altitude, exposing itself to enemy fire for 20 seconds, before returning to low level. When dropped at lower altitudes these 'slick' weapons would travel forward at about the same speed as the aircraft, impacting only a few hundred feet behind it. Normal tactics required a ten-degree climb to around 1400 ft for delivery, placing the aircraft within the envelope of most AAA weapons.

This decision considerably reduced the 474th TFW's ability to hit 'hard' targets like bridges, which were far less vulnerable to smaller Mk 82 SE 500-lb high-drag bombs. On a more positive note, these weapons could be expended in a straight-and-low-level pass at speeds below Mach 0.8, rather than 'toss bombed' in low-level flight as low-drag bombs had to be. Dropping at speeds in excess of 475 knots (the F-111A's best low-altitude speed was above 600 knots) could make the extending Snakeye fins fail, causing bombs to impact and damage the aircraft's ventral fins. In 1986 the introduction of BSU-49/B air-inflatable retard (AIR) fins raised release speed to 600 knots.

Additionally, monitoring sorties by airborne and land-based radar controllers was stepped up and crews had to transmit high frequency (HF) position reports at every turn point along their route. This was regarded as a security hazard since information of that kind could be leaked to enemy defences through the convoluted Saigon intelligence network. In planning routes and tactics, low-altitude target approaches were considered the best defence against SAMs and radar-directed guns, but it became clear that the SA-2's 'Fan Song' guidance radar could lock onto targets below an altitude of 500 ft. This could happen if a TFR initiated a sudden 'fly-up', exposing the aircraft to a 'Fan Song' or AAA radar, which was then difficult to avoid even by returning to a lower altitude. Sixteen SA-2s had been fired at F-111As by the time of the 23 October cessation of bombing in areas above the 20th parallel, and there were 70 occasions when 'Fan Songs' had tracked the aircraft – the prelude to firing a missile.

Hostile radars were defeated with AN/ALQ-87 ECM pods at the time of missile launch or by chaff bundles from the AN/ALE-28 rear-fuselage dispensers. Ejecting two bundles created a chaff cloud about the same size as an F-111. Pilots turned in towards the approaching missile and performed a last-minute vertical 'jink', climbing to around 1500 ft and then rapidly diving to the lowest feasible TFR altitude. If this threat occurred close to the target, WSOs clearly had great difficulty in keeping the target in sight. No confirmed SAM or AAA hits were recorded and MiGs were unable to intercept, although they were known to be

F-111A 67-0067 was sent to Takhli as a replacement aircraft on 23 October 1972. After post-war service with the 366th TFW, it was placed in the USAF Museum at Wright-Patterson AFB, Ohio, complete with dummy Mk 82SE Snakeye bombs. The latter weapon allowed an F-111A to release its ordnance closer to the target without risk of debris damage to the airframe. Interviewed for *Air Force* magazine, 'Roadrunner' WSO 1Lt Steven Glass described a *Linebacker II* mission in which his Snakeye-armed F-111 arrived over Hanoi in mid-evening. 'We came in so fast that we were almost on the release point before any of the lights started going out. Sections of the town were blacked out one at a time, and we knew sirens were screaming and someone down there was pulling master switches even as the bombs left us' (*USAF*)

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CBU dispensers such as the SUU-30B/B were effective weapons for airfield and SAM site attacks. Seen through the canopy of another F-111, hence the aircraft's slight distortion, this 'Roadrunners' F-111A heads out for a target with a 'slant 4' (four per bomb rack unit on the lower and outer attachment points) load of canisters. *Constant Guard V* F-111As had black undersides rather than the dark green of the *Combat Lancer* aircraft, and this scheme remained on TAC F-111s until the early 1990s (*USAF*)

in the air. However, at such low altitudes even a small-arms hit could seriously damage an aircraft, and several of the losses may have occurred in this way. The official view expressed by Brig Gen Richard G Cross, assistant deputy chief of staff, operations, Seventh Air Force, was rather more measured than that of the media;

'There must be some suitable or acceptable loss rate for the F-111 and we must adjust our thinking to this. Otherwise, we should not employ the weapon system in this sort of combat environment.'

The crews' comparative autonomy in route planning could be a defence in itself, as planners realised when 80 per cent of the routes into the comparatively small target-rich area of North Vietnam began to be stereotyped, easing the defenders' tasks. This strategy had cost many aircraft and pilots during *Rolling Thunder* by removing the element of surprise through using predictable routes, timing and attack profiles, but for *Linebacker II* 'Roadrunners' crews were allowed to outwit the enemy rather than following the same recommended route plans based on a limited data-bank of radar imagery. The problem had been recognised at the highest level, as Gen Lucius D Clay, commanding the Pacific Air Forces, observed after five nights of airfield attacks;

'The necessary similarity of daily F-111 operations gives rise to the question of whether the F-111 will be able to survive nightly low-level attacks on the same few air bases. I realise that timing, approach headings and altitudes for attack are difficult to vary, being determined by the main striking force, escape routes and aircraft capability and survivability. It might be appropriate to pick some entirely new targets for variety or diversion to counter the repetitive tactics of the F-111.'

However, the concerns of Gen Clay and Brig Gen Cross proved unnecessary, as the 'Roadrunners' evaded formidable defences night after night throughout the *Linebacker* campaign.

The 23 October bombing restrictions re-directed F-111A operations to Route Pack 1 for missions against truck parks and storage targets like those of the *Combat Lancer* period. Around 20 sorties per night went out. Later in November the wing added interdiction sorties in support of troops in the *Steel Tiger* and *Barrel Roll* operational areas of Laos, halving the sortie rate over Route Pack 1. The 474th still totalled 402 combat sorties for November.

Bombing was controlled by airborne battle command and control centre (ABCCC) aircraft using TACAN bearings and distance-measuring

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equipment at altitudes of 15,000-18,000 ft, with either single- or two-ship formations dropping loads of 24 Mk 82/MAU-93 conical-finned bombs with 16 CBU-58 cluster bombs or four conical-finned Mk 84s from each F-111A.

Night attacks against traffic on the Ho Chi Minh trails were also mounted with good results. Lt Col Jack Funke flew several, noticing that 'it looked like an Interstate Highway with all the headlights. Those were missions when the 20 mm gun would have been handy. It would have been easy to strafe the vehicles before and after the bomb-run'.

However, a new mission was added to the 474th TFW's duties from 11 November 1972 that changed its tasking. The wing would now also fly similar missions to other tactical aircraft working in poor weather. Radar-bombing beacons at five sites in Laos were used as offset aiming points for F-111A bombing systems to support forces defending Long Tieng, also in Laos. Targets, either pre-planned or targets of opportunity (TOO) up to 16 miles from the beacon, could be hit when they were specified by forward air controllers (FACs) or ground commanders. Many were bombed from above heavy cloud cover and the F-111A's accuracy increased the number of missions from 221 (half the wing's total in Laos) in November to 500 in December.

Although F-111A 67-0058 of the 429th TFS was not a double MiG killer, its pilot, Lt Col Robert D Anderson, with Capt Fred D Kjer as his WSO, shot down a MiG-21 whilst flying an F-4C Phantom II on 23 April 1967, as he demonstrates here – the significance of the second red star is unknown. This aircraft, sent to Takhli as a replacement on 21 November 1972, was later put on display at Mountain Home AFB (*Don Laing*)

Usually the F-111As used the beacons to provide range and bearing to the target, and dropped one bomb or a cluster bomb unit (CBU) at the point indicated. If target corrections were needed they came from a FAC on the ground, and then the remaining ordnance would be 'combat dumped' on a second pass. As Brad Insley recollected, 'They only let the experienced crews beacon-bomb, so the young pilots like me had to fly the low-level sorties into North Vietnam, but once we quit bombing around Hanoi we were allowed to beacon-bomb'. Bill Baker felt that 'our indication from the ground operators of the beacons was that it was very accurate, which I don't doubt, knowing the accuracy of the system'.

Other missions into Laos used offset-bombing with an AN/PPN-18 forward air control transponder – by December 1972 more than 90 per cent of missions in Laos employed this type of beacon-bombing. The F-111A's capability in this area was enhanced by the incorporation of a three-option,

In its element as a lone, nocturnal hunter, a 'Roadrunners' F-111A cruises home with empty bomb racks from a mission in December 1972 (*Sgt Richard Sullivan/USAF*)

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range-and-bearing offset aim point selection in its weapons system rather than the single offset that had been thought adequate in the aircraft's original nuclear strike role. A removable offsets panel in the right main instrument panel (programmable pre-flight) provided a multiple offset aim point (MOAP) capability for the F-111A and F-111E.

With such high utilisation in darkness and poor weather, further losses were likely, and the solo nature of the missions reduced the chances of establishing causes. In the case of the 429th TFS's 67-0063 'Whaler 57', lost on 7 November 1972, the North Vietnamese claimed that barrage fire by concerted AK-47s had brought the jet down, resulting in the loss of Majs Robert Brown and Robert Morrissey, after they had bombed a ferry at Luat Son in southern Laos. Wreckage and personal effects were later displayed in North Vietnam, but the crew's fate remains undetermined.

A similar claim was made for the 20 November disappearance of the 430th TFS's 67-0092 'Burger 54' and its crew, Capts Ronald Stafford and Charles Caffarelli, after bombing a freight transhipment depot at Co Giang. However, wreckage washed ashore implied that the crew had not noticed that their TFR was gradually letting them down into the sea. The escape module was probably not deployed and wings were swept to 72 degrees for a high-speed exit. Three other F-111As operating in the same vicinity aborted their missions that night due to particularly severe weather.

In the USA the usual criticisms were heard once again following these losses, with Senator William Proxmire – a habitual enemy of the F-111 – being particularly vocal. The press revived its anti-F-111 campaign with a series of satirical cartoons and damning reports on the new attrition. Gen Ryan set up an enquiry (*Constant Sweep*) to investigate the unexplained crashes and the Tactical Air Warfare Center at Eglin AFB, in Florida, was instructed to focus on the TFR system to try and identify recurrent problems. Spares shortages and faults in TFRs, LARA and attack radars accounted for most of the maintenance issues at Takhli that led to aborted missions or unserviceable aircraft.

It was pointed out that only one aircraft had been lost during 30,000 hours of TFR training at low altitude in the USA, while there had been eight casualties in 6000 hrs of TFR combat flying. The differences in terrain and climate between the two environments, combined with the stress of combat flying in such challenging and unpredictable conditions, were obviously key factors in the higher loss rate suffered by the 474th. Attention was also drawn to the reliance on the F-111A's LARA as the only source of climb and dive commands for the TFR if the latter system's normal returns and attack radar scope were blanked by weather or were transmitted over water. Ex-'Roadrunner' Lee Dodd noted;

'The auto TFR worked well over terrain. Over water the system would go into LARA override, which usually worked okay, but had a very dangerous failure mode. In LARA override the climb/dive commands were generated by the position of the LARA pointer. If this "froze", which it did when it malfunctioned, at an altitude above the one that had been selected, the auto-TFR would descend the aeroplane into the water or the ground.'

On one mission Dodd set the TFR to 400 ft, and as the aircraft crossed the coast he checked the barometric altitude and found that the LARA was reading too high and gradually dropping the jet through 200 ft towards the ocean.

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Over land, with a blanked-out TFR, the crew's radar vision was mainly downward rather than forward, and very steep slopes such as those found in Southeast Asian topography could be encountered without sufficient time to negotiate them. The LARA units in both 'Burger 54' and 'Snug 40' (lost on 18 December) had been unreliable on several previous occasions. 'Hand flying' below the usual minimum TFR altitude to avoid defences obviously incurred other risks.

1Lt Roger Peterson with his F-111A. The 474th TFW patch is displayed to the left of the crew ladder and the separation lines for the crew module can be traced via the diagonal panel lines running to the right of the patch and to the right of the black armament panel above Roger Peterson's head (*Col R Peterson*)

LINEBACKER II

The end of 1972 brought President Nixon's final attempt to force a peace deal from the North Vietnamese with a long-delayed, all-out bombing assault on the Hanoi and Haiphong heartland by 700 B-52 sorties and another 613 by tactical aircraft. Many prime targets that had been off limits since 1965 were cleared for attack.

The earlier stages of the *Constant Guard V* deployment had not allowed the F-111A squadrons to utilise their aircrafts' capabilities fully, particularly in the period from 23 October to 18 December when the majority of missions were medium-altitude sorties over low-threat areas. By *Linebacker II* the planners' confidence in the aircraft had increased, and they were sent against more significant targets where their unique offset radar-bombing equipment could be utilised. Even so, the approach to using F-111s in high-threat areas remained quite cautious, and they were given targets in North Vietnam on only 33 days between 28 September and the end of December 1972, with only 22 days in Route Packages 5 and 6. 'Roadrunners' crews soon showed that their F-111s could take a 'standard' load of 12 Mk 82s or four Mk 84s to hit targets in the far northeast of North Vietnam – a distance of approximately 400 nautical miles in defence-avoiding TFR flight – and return to Takhli with a tenth of their fuel still in reserve.

One problem that prevented the Pentagon's statisticians from properly evaluating the F-111As' success rate was the lack of accurate bomb damage assessment. As their demanding solo missions were flown low and fast at night, it was often impossible for crews to see the full effects of their bombing. Post-strike reconnaissance proved difficult due to cloud cover or a shortage of reconnaissance aircraft to photograph all the F-111As' many targets. This affected the choices of targets for the 474th TFW, as planners did not have enough reliable data to judge the risks of collateral damage in the heavily populated areas where many of the more lucrative targets were situated. It was also hard to tell from the air whether a target previously attacked had indeed been destroyed.

'Just prior to *Linebacker II*', Brad Insley recalled in 2012, 'they called some of us in and we planned targets in secret for 18/19 December – the first night of the operation. It was pretty intense flying up north during this time. For my sortie on the 19th we lost the TFR scope, and although the TFR appeared to be working we aborted and dropped on an alternative target in Laos'.

The 474th TFW contributed 154 low-altitude TFR strike sorties during *Linebacker II* – around 30 per night – while other tactical fighters relied on long-range airborne navigation (LORAN) to bomb through

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cloud or, on only three occasions, used LGBs against targets in central Hanoi when visibility allowed this.

The end of the monsoon season minimised the risk of TFR failure due to rainstorms, crews welcoming the better weather. Roger Peterson recalled;

'If you got caught in a rainstorm they were intense, with rain so loud you could hear it in the cockpit despite wearing a helmet. On my first medium altitude mission we were struck by lightning 60 seconds from the target and lost control of the aircraft. We recovered 2000 ft above ground and managed to return to Takhli with only a radio and magnetic compass – all other electronics were lost. We could not jettison our bombs and had to land with 24 Mk 82s.'

Steve Altick observed, 'We learned some things about TFR from those experiences'.

At first F-111As flew seven daily sorties against airfields in low-altitude TFR mode 20 minutes before B-52 formations arrived (preventing MiGs from taking off to intercept), departing the area at least five minutes before their bombs began to fall. The MiGs of the Vietnamese Peoples' Air Force had little nightfighting capability, and attempted interceptions of B-52s were rare. Airfield bombing, even by single F-111As, temporarily cratered runways. One F-111A sortie against Yen Bai airfield managed to close it down for the night after an onslaught by LORAN-directed A-7Ds and F-4s had caused only superficial damage. Hoa Lac, Phuc Yen, Kep and Bac Mai airfields were also repeatedly bombed. Lt Col Jack Funke recalled one of his 429th TFS missions against Kep;

'We decided to attack from the north, which we figured would be unexpected, so we planned a long TFR route well to the west and north. We screwed up a little and visited China for a short while, but recovered and made our run-in from the northwest, about 20 degrees off the Kep runway heading. All was quiet until the bombs went off and then the whole southeast end of the runway lit up with AAA. I thought we were dead. I "paddled off" the TFR and broke hard to the right. With all the AAA there was no problem seeing the ground. I still can't imagine how we avoided any AAA hits. We did crater the runway, however.'

F-111As had Triple Plow 1 air inlets with hydraulic 'translating' cowls to admit extra air at low airspeeds, as well as a large splitter plate (omitted on later versions of the intake) next to the fuselage side. The most likely source of the F-111's 'Aardvark' nickname was Instructor Pilot Al Mateczun in 1969. 'If you stand in front of it and slightly off to one side, the F-111 has a long sloping nose that might remind one of an aardvark [Afrikaans for 'earthpig']', he observed. Add a pair of raised canopy panels as 'ears' and you have the basis of innumerable F-111 cartoons (*USAF*)

On the first night of *Linebacker II* the 430th TFS was given the infamous Hanoi International Radio transmitter as a target for F-111A 67-0099 'Snug 40', flown by the squadron's Operations Officer, Lt Col Ronald J Ward, and Maj James McElvain. They bombed successfully, although the restrictions on using low-drag Mk 84s, even against a building that was protected by thick blast walls, reduced the damage. The transmitter was taken out later by F-4s with LGBs. Sadly, contact with 'Snug 40' was lost after it went 'feet wet' across the coast. No trace of the jet or its crew was ever found.

Railway marshalling yards and storage buildings also appeared on Takhli's target lists, adding to the damage inflicted by the B-52s. Two bridges were hit too, but the F-111As' 500-lb bombs only caused superficial damage. When B-52 losses to SA-2s

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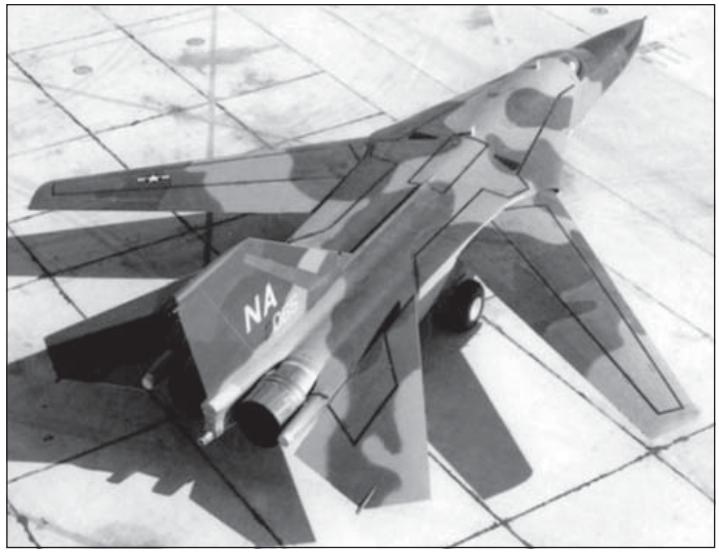
increased on the third night of the operation (six B-52D/Gs were brought down by more than 220 missiles) the focus shifted to the suppression of SAM sites. Rather than using *Wild Weasel* tactics to deter the sites from firing missiles, Strategic Air Command's Commander in Chief, Gen John C Meyer, was in favour of using B-52s, F-111As and A-6As to knock the missile batteries out, with attacks by the tactical bombers around 30 minutes before the B-52s arrived. All SAM sites were focused on the B-52s, and the F-111A sorties did not attract any SA-2s on the first two nights, even though some of the more deeply penetrating missions were flown at medium altitude across large areas of North Vietnam to save fuel.



For most low-level attacks sweep angles of 35-45 degrees were favoured for the best combination of speed and manoeuvrability. Usually, parked aircraft had their wings swept forward to 16 degrees or back to 54 degrees, the latter position also being used for taxiing. For takeoff, the 16 degrees position was re-set, increasing to 26 degrees for climb-out and cruise. F-111A 67-0065 flew both *Constant Guard V* and *Linebacker II* sorties (*USAF*)

Low-altitude attacks by F-111As were aimed at 'area targets' such as airfields, SAM sites and railway marshalling yards rather than the smaller, high-value targets that LGB-carrying F-4 Phantom IIs could hit. The aim was 'destruction, harassment and presence', preventing the North Vietnamese from rebuilding their defences. Although attacks with CBU-58s risked 'self harm' from the lethal stream of bomblets in each canister, they destroyed the widely spaced vehicles and installations on each SAM site more thoroughly than conventional iron bombs. About a third of the F-111A *Linebacker II* missions were against SAM and command and control locations, and all the 474th's sorties against airfields and SAM sites were completed with only superficial damage to a few aircraft, despite the most formidable air defences in military history. Roger Peterson participated in these dangerous missions;

'On one sortie we were attacking a target near Hanoi from the north while my squadron commander hit a target nearby from the south at the same time. We could follow his flightpath by the amount of AAA following his aircraft. They generally fired behind us due to our speed and the difficulty in picking us up visually or on radar.'

However, as Lee Dodd remembered, facing the multi-barrelled, radar-directed ZSU-23 AAA gun was 'a terrifying experience. They produced a solid wall of tracers when they got a lock-on. We had no defence against this weapon. If the Soviets had loaded it with non-tracer ammunition no one would have known they were getting hosed until the aeroplane disintegrated'. Shooting down the elusive F-111s became a top priority for North Vietnamese AAA and SAM batteries, but only one aircraft was lost, to small-arms damage. Gunners tended to fire barrage AAA from about 20 seconds before the F-111A arrived on target until a minute after it released ordnance.

As most of the flak was exploding above and behind the aircraft, crews assumed that the gunners were aiming at the sound of the F-111As. Gunners gradually changed their fusing to detonate at lower altitudes, but pilots countered this by flying as low as 200 ft. As previously noted, gunners

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manning anti-aircraft batteries duly resorted to barrage fire, shooting a curtain of flak ahead of the aircraft's flightpath (sometimes marked by flares, fired to illuminate the approaching F-111's route), although they came close to success only once. Barrage fire was also intended to force pilots to climb into the SAMs' field of influence.

The only 'Roadrunners' crew to become confirmed PoWs were Capt Bob Sponeybarger and 1Lt Bill Wilson on the night of 22 December. Their F-111A (67-0068 'Jackal 33') hit dock facilities in central Hanoi on the toughest night of *Linebacker II*, with a moonlit 1000 ft overcast to reveal their presence to the enemy. Approaching their target at 300 ft and 550 knots, they successfully delivered 12 Mk 82SEs and headed out, but an engine fire light illuminated and they had to shut down the right TF30. Shortly thereafter hydraulic damage, probably from small-arms fire, knocked out the flying controls and they ejected.

Although they were close to Hanoi, both crewmen evaded capture for three days and maintained radio contact with rescue forces, but Capt Sponeybarger was then captured. An HH-53C of the 40th Aerospace Rescue and Recovery Squadron attempted a pick-up, only to take 0.50-cal machine gun fire that wounded the pilot, Capt R D Shapiro, and damaged the helicopter's refuelling probe. Bill Wilson fell as he attempted to grab the HH-53C's jungle penetrator rescue hoist, and as he rolled down a steep slope the rescuers were forced to retreat, landing at a Lima radar site in Laos where their helicopter had to be destroyed. 1Lt Wilson evaded capture for two more days until he was caught while trying to reach a survival package dropped for him by an A-7D. He and his pilot remained in prison until 29 March 1973.

Col Robert Wendrock and Lt Col Larry Crowley, flying to the same target as 'Jackal 33' that night, had severe problems with their TFR and bombing computer. These technical issues were possibly exacerbated by the massive 'corridors' of metallic anti-radar chaff dispensed into the air by F-4s ahead of the B-52 formations. Exiting the target through a torrent of 37 mm AAA aimed visually at their moonlit F-111A, Col Wendrock realised that his altimeter read 75 ft – low enough to see the aircraft's reflection in the rice fields below. At 500 knots even the minimum 200 ft TFR setting placed the aircraft within 0.25 of a second from hitting the ground.

Brad Insley's most memorable mission came on 27 December. Having diverted to a Laotian target after a systems failure, he found that, contrary to the usual rules, another mission awaited him once he returned to base;

'We were told to get a spare aircraft and return to our target, Phuc Yen airfield, as it had to be hit before the B-52s arrived. I didn't know there was that much AAA in North Vietnam, and we were able to subsequently confirm that there was a ZSU-23/4 protecting the target. Once clear of the Red River delta we climbed and then received a 'Blue Bandit' (MiG-21 warning) on Guard radio frequency at our map coordinates. I looked up and saw two MiG-21s go by in the opposite direction, and one turned on us. By the time we started our dive to lower altitude we had a high-band radar lock from the MiG, but our high-band jammer [Sanders AN/ALQ-94 deception jammer] was on and it walked him off into space and dropped him off.

'We were out of the threat zone by this time, so we flew a long way in TFR before climbing again. We had our low-band jammers in standby

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mode and the high-band on in threat areas. The high-band was optimised to defeat the MiG-21, but we felt the low-band gave us away to the SA-2 SAM radars. Once down at low level again the B-52s started coming in, and there was a constant stream of SAM launch warnings on Guard frequency – "SAM launch Hanoi! SAM launch Haiphong! Multiple SAM launch Hanoi!" and on and on. We finally shut off Guard. During *Linebacker I* and *II* we lost six aircraft and five crews, four of them from our squadron, yet the morale of the 430th TFS was always high.'

THE FINAL PHASE

With the end of *Linebacker II* on 29 December and the resultant ceasefire, there was a ten-day lull for the 'Roadrunners'. 'All of a sudden haircuts and uniforms became important again until they decided we could be of use in Laos', Brad Insley recalled. Takhli's F-111s duly performed an additional 698 missions in Route Pack 1 and Laos.

Among them were Pathfinder missions, where the jet's superior navigation/attack systems were used to lead A-7D Corsair IIs or F-4 Phantom IIs to *Barrel Roll* targets in Laos after offensive operations over North Vietnam ceased on 15 January 1973. The USAF had previously advocated similar missions over North Vietnam, but the slow speeds required for this medium-altitude bombing made the aircraft very vulnerable. Crews could extend their mission times by in-flight refuelling, remaining 'on call' for instructions from 'Moonbeam' or 'Cricket' airborne controllers to provide 'buddy bombing' facilities for additional strike packages that had encountered poor target visibility. Weapons ballistics details for aircraft like the F-4 or A-7 were stored in the F-111A cockpit in case they were required. Col Larry Peters recalled these missions;

'We simply asked the A-7 or F-4 guys what they were loaded with and we put that data into our computer. Their loads were mostly dumb iron bombs – 500-, 1000- or 2000-lb "slicks" [Mk 80 series warheads with low-drag fins]. Initially, these would be fragged [pre-planned] sorties with compatible loads. However, later on pathfinding tactics were used when the "bomber" aircraft were already airborne and their targets became socked in by weather. In that case the air controllers would get us joined up, and if our ordnance loads were not compatible we would usually drop their bombs first and then make another pass to drop ours, or just request another target.'

Brad Insley also flew plenty of these missions;

Another view of *Constant Guard* F-111A 67-0072, seen here awaiting nightfall and another low level, terrain-following mission. The most difficult TFR situation was when the aircraft was approaching ground higher than its own altitude, with still higher terrain beyond that, because the SIT (situation display) and E-Scope displays on the radar screens tended to only show the first obstacle to be crossed. In route planning for poor weather, minimum TFR altitudes of 200 ft above the highest obstacle expected on the route were required. The TFR knob on the terrain clearance panel had six options – 200, 300, 400, 500, 750 and 1000 (ft), with the 500 marked 'WX' for all-weather. This option limited the ground area covered by the TFR forward scan and reduced the warning distance to upcoming terrain obstacles. Each selected altitude had tolerances on it – e.g. '200' allowed from 170 ft up to 300 ft (*USAF*)

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'We would also lead other F-111As if they lost radar or INS. We once refuelled twice waiting for another F-111A to pathfind for us when we lost our radar. Our target was in the Plain of Jars and no-one was nearby to help us.'

Bill Baker reckoned that 'buddy bombing was only done in Cambodia because the terrain was flat and not loaded with mensurated coordinates for radar acquisition. B-52s could join on the wing of the F-111A and we would call the release for them'.

Four aircraft were involved in mid-air collisions on these combat missions. While changing formation lead positions 67-0071 and 67-0098 collided, but both recovered safely to Udorn RTAFB with relatively minor damage. However, the crews of 67-0111 and 67-0094 were less fortunate on 16 June in similar circumstances when confusion arose over which aircraft was leading the flight on an F-4 Pathfinder mission. Maj Robert McConnell and Capt Richard Skeels had to eject from the former F-111A as the damage made it uncontrollable, while Col Ken Alley and Maj Glen Perry managed to get 67-0094 back to Udorn despite losing more than four feet of its wing. They touched down at 240 knots, destroying the base's BAK-9 mid-field emergency landing arrestment gear, but 67-0094 flew again after repairs.

Larry Peters experienced another operational mishap at Takhli;

'I took off and my landing gear jammed and wouldn't come up. I had blown the right landing-gear strut and I had 24 500-lb bombs aboard. I was extremely heavy to say the least and could not proceed with the mission. I was directed by Takhli mobile control to return to base and make a low approach so that they could look at me. The first mistake I made was to forget that as pilot I was ultimately responsible for my pink ass, as the "adult leadership" at Takhli were only concerned about their aircraft.

'There was a bomb jettison area near Korat just over 100 miles away, and I should have gone there right off the bat, but because there was all this "adult leadership" to make my decisions for me I stayed at Takhli and kept making low approaches. Finally, they directed me to dump fuel to make the aircraft as light as possible and land with the bombs. I didn't have enough gas to get to the jettison area and I was still so heavy that an approach-end barrier engagement was out of the question. I landed on the left side of the runway, away from the blown strut, and once the weight of the aircraft settled onto the damaged strut it made the aircraft

A-7D Corsair IIs, like this 3rd TFS/ 388th TFW example, shared Korat RTAFB's runways and attack duties with 347th TFW F-111As from mid-1973 to June 1975. The Corsair IIs deployed as partial replacements for F-4s from the 469th TFS, leaving Udorn RTAFB-based Phantom IIs to cope with the escort and MiGCAP duties. F-111A 67-0096 previously flew with the 430th TFS at Takhli RTAFB (*USAF*)

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67-0072 flew with the 429th TFS during its *Constant Guard V* deployment until 20 February 1973, when a main landing gear strut failed as the aircraft took off from Takhli RTAFB. It slid off the runway at a little below takeoff speed on its bomb-load of 24 500-lb Mk 82s. Lee Dodd witnessed the incident; 'The subsequent fire and explosions continued all night, with no fire-fighters able to approach the inferno. The crew survived, with one rescued in a brave move by the air force police in an armoured truck. He was running so fast that the occupants of the truck, with a top speed of 15 mph, had to call to him to slow down so that they could catch up!' (*USAF*)

pull to the right side. I finally got stopped just before going off the right side of the runway and everyone lived happily ever after.'

F-111A 67-0072 was an operational casualty on 20 February. Its undercarriage folded up on takeoff when a similar strut fractured and it careered off Takhli's runway in flames, leaving its crew with little time to exit the cockpit before the jet's 24 Mk 82 bombs began to explode throughout that night.

More than 4000 combat sorties would ultimately be flown by the 474th TFW in 1972-73, the aircraft involved mostly being armed with Mk 82 bombs – some medium-altitude sorties above 15,000 ft carried Mk 84s and CBU-58s. The six combat losses during 1972 represented a loss rate of 0.015 per cent, which was a significant improvement on the attrition suffered by 'Ryan's Raider's' F-105Fs and US Navy A-6As flying similarly demanding missions. This figure was also the best for any combat aircraft involved in the Vietnam War. Typically, the missions undertaken by the F-111s saw the aircraft flying close to the ground at high subsonic speeds, each jet being armed with 12 Mk 82s. The missions usually lasted two-and-a-half hours, and crews had no tankers, ECM or fighter support.

During *Linebacker II* F-111As typically carried double the payload of an F-4 Phantom II more than two-and-a-half times as far, making it in many ways the most cost-effective aircraft of the war. In its analysis of *Linebacker II* the USAF regarded improvements in weapons delivery and TFR use as the major advances in the F-111's operational effectiveness, and saw a 'broadening role' for it in future.

On 22 March 1973 the 428th TFS took possession of the 430th TFS's surviving aircraft. Takhli's two F-111A squadrons were reassigned to the newly reactivated 347th TFW and subsequently moved with the wing to Korat RTAFB. The 347th had initially been reactivated at Mountain Home with three squadrons of F-111Fs in May 1971, the wing then becoming the 366th TFW in October 1972.

At Takhli, the 347th TFW F-111As, re-coded 'HG', flew the last *Constant Guard* sorties into Cambodia until the ceasefire came into effect on 15 August 1973. The wing's final mission was flown that day at 1100 hrs from Korat, striking insurgents ten miles from Phnom Penh. The jets' ordnance loads were 24 Mk 82s, and F-105G 62-4444 flew ECM escort for them. Thereafter they remained at Takhli in case hostilities

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resumed – a period that was briefly enlivened by organising a live-firing armament demonstration at Osan AB in South Korea.

The 'beacon-bombing' missions over Laos continued into 1973, and to Larry Peters it was 'a very good way to get bombs on a worthy target and hurt the enemy. If you flew over Laos all you saw was thick jungle and mountains. "Red Dog", the CIA's controller, had a beacon transmitter we could pick up on our radar. He would give us a bearing and a distance to his target. We would select offset bombing and enter the information he gave us. It was very, very important that we selected offset mode, otherwise we would have bombed the beacon site'.

These covert missions resulted from an agreement between Gen John Vogt, Seventh Air Force commander, and Gen Vang Pao, leader of the indigenous Laotian Hmong people, to use F-111As to drive the North Vietnamese from the Plain of Jars area. Working with Group Mobile battalions of Laotians, the CIA conducted its biggest ever paramilitary operation in the area. Although the CIA initially had misgivings about the F-111A's reputation, the jet's accuracy in offset bombing became a vital element in the campaign. 'Red Dog', using anonymous 'Hmong Talker' FACs, could divert F-111s to targets of opportunity within close proximity of the Laotian forces. In one particularly impressive strike a single aircraft was called in to attack a 130 mm artillery piece menacing Thai and Laotian troops, and the gun was blown clean out of its pit by Mk 82 bombs.

When Takhli was returned to the Thai government on 12 July 1974, the 347th TFW moved to Korat RTAFB, from where it participated in the recovery of the SS *Mayaguez* – a merchant vessel that had been captured by Cambodia's Khmer Rouge on 12 May 1975. When the ship was detected off Poulo Wai island by a P-3 Orion reconnaissance aircraft of the US Navy, Thai-based F-4 Phantom IIs and A-7D Corsair IIs were alerted and F-111s were sent to intervene, having been chosen for their range and superior communications equipment. Lt Col Ed Wells, commanding the 429th TFS, recalled;

'In the very early morning hours after the hijack we launched a flight of two F-111As ["Ellis" flight] led by Maj "Fast" Eddie Chase. Our role was to provide air cover "24/7" in order to prevent the Khmer Rouge from re-supplying the ship or the nearby island of Koh Tang. Each flight of two was loaded with four Mk 84 bombs.'

F-111A 67-0070 was one of the first *Constant Guard V* arrivals at Takhli on 1 October 1972, and it was transferred to Korat RTAFB when the 429th TFS was reassigned to the 347th TFW from July 1973. Gun modules and twin AN/ALQ-87 ECM pods are carried by this pair of jets, seen here preparing to make a fairly rare hook-up with a tanker en route to base whilst returning from a mission over Laos. Post-war, both of these aircraft joined the 366th TFW at Mountain Home (*USAF*)

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As the *Mayaguez* halted near Koh Tang, the lead F-111 got a solid radar return from the ship. Lt Col Kenneth Law, in the second aircraft, noted;

'My scope vectored around and the ship's return banged in – there was no doubt. Lead went down for a low pass to get a look at the name – it was definitely the *Mayaguez*. Several small PT-type boats were near the hull. As "Ellis 1" and I screamed by her at deck-top level, the gnat-like boats peeled away and headed for the Cambodian mainland.'

Two more F-111s made low passes over their bows, the jets being crewed by Majs David Anderson and Steve Altick. The latter recalled;

'My WSO was trying to set up the radar when I decided to have him switch to "manual" so I could "eyeball" the bombs in front of the boats. We expended Mk 84 bombs at the boats that were trying to leave the island, laying them down in front of the vessels and creating huge water geysers that turned them around. It worked pretty well. The controlling aircraft was a C-130 ABCCC, which was receiving its orders directly from the Pentagon over HF radio.'

As the situation escalated, three of the vessels were eventually sunk – one by a direct hit with a Mk 84 from an F-111A flown by Lt Col George Peacock, Operations Officer of the 428th TFS. 'The bombs were fused for a surface burst', Lt Col Wells explained, 'and they produced a tremendous destructive blast. The 347th TFW crews also dropped bombs just ahead of a trawler that was believed to be carrying the *Mayaguez* crew to another island or the mainland harbour at Kompong Som.

'"Mo" Seaver [previously the wing commander, and an F-105 MiG killer] and I had agreed that no crew could fly more than one sortie until everyone had been on one. I found some free time near the end and took the dawn patrol, arriving on the scene just as the sun was beginning to show above the rim of the South China Sea. As it grew lighter I saw a wisp of smoke far off to the east. It was the frigate USS *Harold E Holt*, and before it made contact we called in a flight of A-7s to "dust" the decks of the *Mayaguez* with "get sick" gas bombs. The *Holt* pulled alongside, and the Marines swarmed on deck and found no resistance, but no crew.

'That done, we returned our attention to the harbour, and after a long delay a fairly large boat ventured out. I was short of fuel, so Capt Cox made a very low pass for a good look. On deck he saw the entire crew of the *Mayaguez* prominently displayed at the foredeck rail.'

The fishing boat was intercepted by the destroyer USS *Henry B Wilson* (DDG-7), which took the 40 *Mayaguez* crewmen aboard. President Gerald Ford had pre-ordered attacks on mainland naval targets and a 'show of strength' US Marine attack on Koh Tang Island on 15 May, supported by F-111As and A-7Ds. For Steve Altick it had been a historic mission. 'I was flying with the 428th TFS that day, almost ten years on from participating in the first large missions into North Vietnam in F-100D Super Sabres, also with that squadron. So I was, in effect, on their first and last missions of the war'.

The Korat deployment ended on 30 June 1975 when the F-111As finally returned to Nellis AFB and 474th TFW control. In mid-1977 the wing transferred its A-models to the 366th TFW after the latter had passed its F-111Fs on to the 48th TFW at Lakenheath, in Suffolk, as part of Operation *Creek Swing/Ready Switch*. The 474th received the 48th's F-4Ds in return, thus ceasing F-111 operations for good.

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EL DORADO CANYON

For newcomers to RAF Lakenheath, the base Relocation Assistance Program video assured them that, 'Your tour in England will be one of the most memorable of your Air Force career'. For some of the participants in Operation *El Dorado Canyon* in April 1986 that was probably a major understatement.

Tensions between the USA and Libya that led to the 15 April 1986 attacks on Libya by UK-based F-111s and Sixth Fleet aircraft carriers had steadily increased since the mid-1960s, but the persistent support for terrorist acts by the Libyan leader, Muammar al Gaddafi, brought them to a head in the early 1980s. The inauguration of President Ronald Reagan, elected on a campaign promising 'swift and effective retribution' for terrorists, in January 1981 brought the first indications that the US administration would use military action to enforce a tougher stance on terrorism, for which Libya was identified as 'the most prominent state sponsor'.

Libya was the USA's third largest oil supplier, but this trade ended after a pair of F-14As from VF-41 'Black Aces', flying off USS *Nimitz* (CVN-68), clashed with Libyan Sukhoi Su-22 'Fitters' on 19 August 1981, shooting two down as the US Navy challenged Libya's claim to the Gulf of Sidra and scored the first US aerial kills since the Vietnam War. An additional 160 interceptions of Libyan fighters were made over the following eight months, although none of these resulted in aerial combat.

After the murder of Egyptian President Anwar Sadat on 6 October 1981 – an act applauded by Gaddafi, who had earlier threatened to assassinate President Reagan – USAF E-3A AWACS aircraft were stationed in Egypt.

A four-ship of 522nd TFS 'Fireballs' F-111Ds from Cannon AFB formate for a photo-flight over the pyramids during the unit's 1983 *Bright Star* deployment to Cairo West. Deriving from the Camp David Accords, these biennial combined forces, multi-national demonstrations of ongoing support for Egypt began in 1980 and continued after *Desert Storm* (*USAF*)

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During Exercise *Bright Star '81*, staged a short while later, B-52s carried out 'show of strength' bombing demonstrations in the Egyptian western desert. This was combined with a covert plan, cancelled due to journalists' leaks, to entice Gaddafi into mounting air attacks on the Sudanese capital of Khartoum, whereupon his air force would have been decimated by AWACS-controlled Egyptian fighters. Another contingency plan in November 1981 called for attacks on Libyan terrorist training facilities by four 48th TFW F-111Fs. Four crews (including three officers who eventually flew in *El Dorado Canyon*) were assigned to this 'Gold Team' of potential attackers. In August 1983 F-111Ds of the 27th TFW deployed to Cairo West for another *Bright Star* to demonstrate US commitment.

Reports of intended attacks on American politicians and installations by Libyan and Palestinian agents became more frequent, and by November 1983 US defence chiefs were advising air attacks on Libyan terrorist training camps, airfields and naval bases. Lethal terrorist attacks on US personnel in Beirut, Kuwait and Tehran brought increasing American public demands for military retaliation, and suggestions that Reagan was too hesitant to use it. In 1985 Gaddafi's activities reached new levels when he supported the extremist Abu Nidal in attacking the Italian cruise liner *Achille Lauro*, killing an invalid American, and in his hijacking of an Egyptian airliner in November 1985. This was followed by the murder of 20 civilians in airport attacks in Rome and Vienna.

In Washington, D.C. the National Security Council (NSC) immediately began to explore the military options for dealing with Libyan terrorist facilities, which theoretically included daylight raids by USAFE F-4E Phantom IIs and F-16As or attacks by B-52 bombers or cruise missiles. The latter eliminated risk to US aircrew, although the prospect of cruise missile technology falling into Soviet hands was problematic, as was the use of the F-117A Nighthawk stealth bomber, which remained secret until December 1988. Also, international re-deployment of B-52s and cruise-missile ships risked alerting Gaddafi's forces. However, there was already an 'on the shelf' draft plan at the Pentagon that had been prepared by the Air Staff several years before.

Col Bob Brotzman was F-111 Program Element Monitor at the time, and in discussions with senior USAFE and 48th TFW staff the concept of coordinated attacks by A-6E and F-111F units was forged 'in case Gaddafi's threats against President Reagan were acted upon. We settled on 12 F-111s coming in from different attack headings, hitting several targets within a short space of time. One assumption was that we would get over-flight permission from the French'. Col Brotzman and a US Navy A-6 Intruder expert then gave a briefing on the plan in the Pentagon;

'There was a lot of rank in the room, including three and four-star generals from both Air Force and Navy. During follow-on questions we were asked how confident we were that the targets could be hit with reasonable collateral damage, as

The PAVE Tack pod on this F-111F (72-1444) has been rotated 90 degrees to allow its sensor head to mark targets and guide the four GBU-10 weapons from the wing pylons. A *Desert Storm* participant, '444' (seen here in 494th TFS 'Panthers' colours over Lakenheath before *El Dorado Canyon*) survived a major engine fire during a low-altitude sortie in October 1991. Pilot Capt Craig Brown recovered the aircraft to RAF Lossiemouth and it continued in service at Cannon AFB until April 1996 (*USAF*)

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On 14 April 1986 an F-111F armed with 12 Mk 82 AIRs fitted with BSU-49 retarding devices leaves Lakenheath in fading light bound for Tripoli airport. 'Puffy' and 'Lujac' flights were assigned to this target, and they took off first from 1735 hrs as they had the furthest distance to cover. One of the eight aircraft assigned to the mission was a spare, and two others had to abort en route or in the target area. A successful attack required pilots to transmit the coded message 'Tranquil Tiger', while a miss or aborted attack was indicated by code words 'Frosty Freezer' (*SSgt Dale Woodward/USAF*)

several were right in the city. The A-6 guy basically said he wasn't that confident because their navigation/attack system was older, and the lash-up between that system and the TRAM [target recognition/attack multi-sensor, housed in an add-on under-nose turret fitted to the A-6E, with a similar function to the F-111's AN/AVQ-26 PAVE Tack] wasn't that great. I said I was pretty confident, and showed them a videotape of F-111F cockpit displays during a PAVE Tack bomb-run, right through to bomb impact. Jaws dropped around the table as they saw the quality of the PAVE Tack imagery. The next day the NSC was briefed and the F-111 option "won". The plan was tidied up and put on the shelf, and eventually used with relatively few changes in 1986.'

PAVE TACK

Although the Ford Aerospace/Loral AN/AVQ-26 PAVE Tack laser and infrared detection pod saw only limited use by RF-4Cs and F-4Es, it was extensively employed by the F-111F force. PAVE Tack had a Texas Instruments AN/AAQ-9 FLIR to detect targets at a range of around ten miles, whilst its AN/AVQ-25 laser designator and rangefinder units on either side of the FLIR in its rotating turret head worked at shorter distances. It was usually extended from the weapons bay just before the initial point (IP) – the turning point immediately prior to reaching the target. The pod also contained drive motors, power supplies, electronics, a 16-bit computer and a video recorder. Former 48th TFW WSO Maj Jim Rotramel explained its use;

'As the F-111F approached the target area the pod took a few seconds to rotate down into position and cue to the radar crosshairs, so good radar work was absolutely crucial when it came to enjoying success with the pod. Most WSOs moved from the radar screen to PAVE Tack [on the virtual image display (VID), with its six-inch screen – double the size of the radar screen – on which PAVE Tack imagery appeared] only when the aircraft was "in the pull" [climbing during its toss manoeuvre]. The WSO then acquired, and viewed, the target in monochrome on his video display, which gave only a five-degree field-of-view at its widest (like looking through a soda straw), selecting the optimum aim point for his LGBs. The pod's cross-hair sight was duly placed on target, the latter then being "lasered" to provide precise ranging information to the weapon delivery computer right up to the point of bomb release.

'As the WSO manually tracked the target, the computer cued the pilot to "paddle off" [disengage] the TFR and perform a 4g pull-up about 20,000 ft from the target. The crew then "tossed" the bombs from an altitude of 650 ft with a 20-degree nose-high angle some 16,000 ft from the target. With the ordnance gone, the pilot began a turn away from the target, apexing at about 2000 ft in 110 degrees of bank, before eventually returning to TFR flight on a course about 135 degrees from the original heading. *(text continues on pg 46)*

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COLOUR PLATES

1

F-111A 66-0016 of Det 1, 428th TFS/474th TFW, Takhli RTAFB, Thailand, March 1968

2

F-111A 66-0024 of Det 1, 428th TFS/474th TFW, Takhli RTAFB, Thailand, April 1968

3

F-111A 66-0021 of Det 1, 428th TFS/474th TFW, Takhli RTAFB, Thailand, March 1968

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4
F-111A 67-0076 of the 429th TFS/474th TFW, Takhli RTAFB, Thailand, November 1972

5
F-111A 67-0068 of the 429th TFS/474th TFW, Takhli RTAFB, Thailand, December 1972

6
F-111A 67-0078 of the 429th TFS/474th TFW, Takhli RTAFB, Thailand, September 1972

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7
F-111A 67-0098 of the 430th TFS/474th TFW, Takhli RTAFB, Thailand, October 1972

8
F-111A 67-0081 of the 429th TFS/474th TFW, Korat RTAFB, Thailand, May 1975

9
F-111F 70-2386 of the 493rd TFS/48th TFW, RAF Lakenheath, England, April 1986

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10
F-111F 73-0707 of the 494th TFS/48th TFW, RAF Lakenheath, England, April 1986

11
F-111F 71-0889 of the 493rd TFS/48th TFW, RAF Lakenheath, England, April 1986

12
EF-111A 67-0052 of the 42nd ECS/66th ECW, RAF Upper Heyford, England, April 1986

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13
F-111F 70-2387 of the 493rd TFS/48th TFW, RAF Lakenheath, England, April 1986

14
F-111F 70-2391 of the 495th TFS/48th TFW(P), Taif, Saudi Arabia, January-February 1991

15
F-111F 71-0884 492nd TFS, 48th TFW(P), Taif, Saudi Arabia, January-February 1991

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16
F-111F 70-2370 of the 494th TFS/48th TFW(P), Taif, Saudi Arabia, January-February 1991

17
F-111F 72-1450 of the 494th TFS/48th TFW(P), Taif, Saudi Arabia, January-February 1991

18
EF-111A 66-0030 of the 390th ECS/48th TFW(P), Taif, Saudi Arabia, January-February 1991

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19
EF-111A 66-0056 of the 42nd ECS/66th ECW/48th TFW(P), Taif, Saudi Arabia, January-February 1991

20
F-111E 68-0036 of the 55th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, February 1991

21
F-111E 68-0014 of the 55th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, February 1991

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22
F-111E 68-0046 of the 77th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, March 1991

23
F-111E 68-0026 of the 55th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, March 1991

24
F-111E 68-0029 of the 55th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, February 1991

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25
F-111E 68-0049 of the 79th TFS/20th TFW, RAF Upper Heyford, England, July 1991

26
F-111E 68-0083 of the 79th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, February 1991

27
EF-111A 67-0042 of the 42nd ECS/20th TFW/7440th Wing (P), Incirlik, Turkey, March 1991

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28
EF-111A 66-0013 of the 429th ECS/27th FW, detached to Incirlik, Turkey, and Dhahran, Saudi Arabia, 1994

29
EF-111A 66-0044 of the 429th ECS/27th FW, Dhahran, Saudi Arabia, 1995

30
RF-111C A8-143 of No 1 Sqn, 82 Wing RAAF, Tindal Air Base, Northern Territory, September 1999

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The four 'Harpo' EF-111As providing electronic jamming for the F-111F attacks ('Harpo 75' was the air-spare) passed through the Straits of Gibraltar after their final refuelling. Nearer the target area they popped up from low altitude to begin their jamming patterns, although 'Harpo 72' withdrew after an equipment breakdown. Two EF-111As had been pre-positioned at Lakenheath in anticipation of a six-F-111F attack, but they returned to Upper Heyford and launched with three others when the bigger 'armada' of F-111Fs was required. 42nd ECS Ravens were still traversing the Straits of Gibraltar in 1989, when this photograph was taken, in support of *Open Gate*, an exercise to protect shipping in the area (*USAF*)

'During this manoeuvring the WSO continued to track the LGB's desired mean point of impact [DMPI] on his VID using the six-inch screen, again firing the laser at the DMPI once the bomb entered its downward trajectory. This would cause the weapon to follow the laser "spot" until impact, steered by its guidance fins. While the bombs were in flight the WSO had to keep the laser spot focused on the DMPI while ignoring the sensation of falling inverted! While rain and dense smoke (probably from nearby bomb detonations) could blind the pod, haze was essentially invisible to it.'

Toss manoeuvres were usually made from a TFR approach at 200-500 ft and 540 knots (620 mph). Lakenheath crews had practised similar manoeuvres over the North Sea against British coastal towns that spring.

As the terrorist situation degenerated President Reagan severed economic ties with Libya and ordered the return to the USA of American civilians, including oil workers from five US companies still operating in the country. However, more conclusive proof of Libyan involvement in the Abu Nidal attacks was needed, even though Gaddafi's increasing isolation from the rest of the world made those attacks more feasible than attempts to destroy the terrorists' network elsewhere. On 27 December 1985 a warning order codenamed *Prime Pump* had been issued to defence chiefs, outlining a long-range strike and seeking proposals.

A previous feasibility mission by the 20th TFW also contributed to the planning. Operation *Ghost Rider*, a long-range strike from the UK on a simulated airfield 100 miles southwest of Goose Bay, Labrador, by ten F-111Es (with four spare aircraft) was conducted on 18 October 1985. It involved flying in four-aircraft formations rather than the usual 'two-ships' that were favoured due to the pilots' limited visibility to starboard. The wing was given 46 hours to plan the top-secret mission, flying 3000 miles each way with eight inert Mk 82 retarded bombs per F-111E. Maintenance Officer Col Pat Barry selected the ten most reliable aircraft, which were to be flown by the most experienced crews. Brig Gen Dale Thompson, the wing commander, was mission commander in one of the 17 accompanying KC-10A and KC-135A tankers. The F-111E elements were led by the wing's three squadron commanders, Lt Cols Joe Narsavage, John Cain and Pete Granger.

Dropping to low altitude 150 miles from their first checkpoint in Newfoundland, the F-111Es conducted their attacks using classic single-aircraft TFR tactics – approaching at an altitude of 400 ft and a

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speed of 480 knots, one minute apart. Bombing was by radar in darkness, and the target was directly hit by more than 50 per cent of the bombs within a few seconds of the planned time-on-target after a six-hour flight.

Many of the elements of Operation *El Dorado Canyon* were tested and proven in *Ghost Rider*, including the vital coordination procedures with tankers – particularly the idea of keeping each F-111 element with a dedicated tanker throughout the mission. In January 1986 Upper Heyford's EF-111As would be added to the Lakenheath-centred plans for the Libya attack, although its F-111Es were not included in the final strke.

There was another 'rehearsal' for the Libya mission in February 1986 that involved the F-111D-equipped 522nd and 523rd TFS/27th TFW at Cannon AFB, New Mexico. The 523rd TFS was led by Lt Col Bob Pahl, who recalled;

'A buddy of mine came in from TAC HQ and had us all get together and shut the door. He then said, "We need you to plan a mission that will last around 12 hours. Halfway through it you will bomb the range at Eglin AFB at 0130 hrs with four Mk 84s each, and there must be at least five tanker hook-ups. You also have to fly up to Mountain Home AFB, where you will meet up with some EF-111As". So we planned the mission, loaded the aeroplanes, and got airborne in what [for Cannon] was miserable, cold weather.

'They had specifically said we want you to drop ordnance at 550 knots, which in the F-111D meant using minimum afterburner. We had eight aircraft screaming around a hotel at Fort Walton Beach, in Florida. You can imagine the noise. Two of the aeroplanes had to make repeat passes. I'm sure they received a thousand calls to the base that night, but no one there would have known much about the mission. I logged 13.5 hours on that sortie.

'A couple of months later as I climbed out of the cockpit after returning from a sortie, one of the maintenance folks shouted to me, "Hey, we bombed Libya! They had to fly around Gibraltar because the French wouldn't let them in". All of a sudden a huge "light bulb" switched on in everyone's head – they anticipated months before that the French weren't going to let them over-fly, and we had flown that mission to Florida to prove that it could be done.'

A final demonstration of the F-111F's accuracy was mounted and filmed on 2 April 1986 when two 493rd TFS aircraft each dropped four GBU-12s on a German range, scoring direct hits with all weapons.

In the first hour of New Year's Day 1986, Col Sam W Westbrook III, 48th TFW commander, received orders from the Joint Chiefs of Staff (US Armed Forces) to send a four-man team to USAFE Headquarters at Ramstein AB, West Germany, to be briefed on a 'special tasking'. Included in the team was one of his squadron commanders, who would subsequently fly on the Libya mission in F-111F 'Remit 31'. EF-111A personnel from the 42nd Electronic Combat Squadron (ECS) were also present at subsequent Ramstein meetings, and at Lakenheath to work with 48th TFW planners.

Four F-111Fs (plus two spares) would be required to fly at night across France to hit Tripoli and Benina airfields and the Murat Sidi Bilal terrorist training camp at 0200 hrs local time with either four GBU-12D/B

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or 12 Mk 82 'dumb' bombs. Such a small force would theoretically achieve complete surprise. Another of the team (who would fly in 'Elton 42') was given target photographs to study. The team planned the mission for presentation to Gen Bernie Rogers, Supreme Allied Commander, on 4 January. They also briefed Gen Charles Donnelly, commander of USAFE, who, with Gen Charles Gabriel (USAF Chief of Staff), had congratulated the 20th TFW on its 'dress rehearsal' *Ghost Rider* mission.

Donnelly decided that all six F-111Fs should fly the complete mission. He also insisted on 2000-lb GBU-10E/B LGBs rather than the 500-lb GBU-12D/B ordnance that the crews knew would be more accurate. GBU-10s were known to land about 150 ft short of the target from a low-altitude 'toss' delivery, as it was four times heavier than a GBU-12 with guidance fins that were only twice the size. Usually, a 'lag' factor was entered into the computer to allow for this, aiming the bomb past the target to give it more 'energy' while it was guiding to compensate for the tendency to land short.

Other plans envisaged four or six aircraft making over-water or over-land attacks on the Bab al-Azizia complex to minimise time-over-target, using separated tracks to avoid interference between TFRs. However, rising media speculation about an impending attack, citing the 48th TFW as the likely executor, frustrated this possibility, as did the need to avoid EF-111As crossing the coast and risking the loss of their classified ECM equipment. Action was delayed and intensive discussion of 36 likely targets resumed for another three months, with an offensive action led by Egypt remaining firmly on the table. Meanwhile, CBS and NBC camera crews, prompted by leaks from Washington, D.C. to the media, had already filmed activity at Lakenheath from off-base vantage points on the assumption that coverage would soon be needed for their news broadcasts.

Meanwhile, with Soviet assistance, the Libyans built SA-5 'Gammon' SAM sites on the coast at Sirte, and continued to intercept US reconnaissance aircraft well beyond Libyan airspace, using intelligence supplied by a Soviet vessel docked in Tripoli harbour. President Reagan responded by reinforcing Sixth Fleet's carrier assets in the Mediterranean, ordering USS *America* (CV-66), with Carrier Air Wing (CVW) 1 embarked, to head to the region to operate alongside the already deployed USS *Coral Sea* (CV-43), with CVW-13 on board. According to the commander of Sixth Fleet, Vice Adm Frank Kelso, the doubling of US Navy assets in-theatre proved that 'we could operate in international waters and not be blackmailed by Gaddafi into thinking that the Gulf of Sidra is his lake'.

Nevertheless, Gaddafi's huge defence network was taken seriously, particularly his Libyan Arab Air Force Mirage F 1ED and MiG-25 'Foxbat' fighters, which were often flown by foreign mercenary pilots. These jets were routinely intercepted by US Navy F-14A Tomcats and F/A-18A Hornets flying combat air patrols (CAPs) under Rules of Engagement described in Operation *Prairie Fire* – a series of graduated US responses to Gaddafi's actions ranging from full task force defence to an all-out attack on the country's infrastructure in the event of significant Libyan aggression. Throughout, the 48th TFW's F-111s were kept on alert.

When two SA-5 'Gammon' missiles were launched at Tomcats from VF-102 providing a CAP for the cruiser USS *Ticonderoga* (CG-47)

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on 24 March, the tension off Libya's coast was increased. A-7E Corsair IIs from VA-83 duly responded by threatening the SA-5s' 'Square Pair' radar sites with AGM-88 High-speed Anti-Radiation Missiles (HARMs), shutting the radars down. Later, A-6Es from VA-34 used an AGM-84A Harpoon missile (its first combat usage) and Rockeye CBUs to sink the advanced, French-supplied cruise missile boat *Waheed* that was approaching the US Navy battlegroups. Two more gunboats were destroyed or badly damaged in the following 24 hours. The final act of *Prairie Fire* was the destruction of a *Nanuchka II* corvette on 25 March with Harpoon and Mk 20 Rockeye II weapons.

The US challenge had succeeded and Gaddafi's massive forces were demonstrably disorganised and ineffective in combat, although their leader's grandiose threats continued unabated and his revenge came quickly. Libyan agents throughout Europe were ordered to commit further terrorist attacks on US personnel. A TWA airliner on approach to Athens airport was damaged by a bomb, killing four Americans, and another bomb exploded in a West Berlin disco on 5 April, killing two more Americans and injuring 87 others. Both sets of attackers received public congratulations from Gaddafi. For President Reagan this fully justified a major air strike to try and curb Libyan terrorism in particular, and to send a warning to perpetrators of terrorism in general. In Secretary of State George Schultz's words, 'We have taken enough punishment and beating. We have to act'.

Operation *El Dorado Canyon* was initiated on 7 April, but the choice of targets was still contentious as the overall aim was to identify sites directly related to terrorist activity, with minimal collateral damage, rather than alienating elements in Libya that might help to topple Gaddafi. Many of the potential targets (the list had risen to 152 in March) were in heavily populated areas, or near Libyan defences that could cause the unacceptable loss or capture of US aircrew. However, Gaddafi's power base in the 200-acre Bab al-Azizia compound, close to a hospital and foreign diplomats' hotels, remained a high priority despite the Libyan leader never being directly targeted. Indeed, mission planners were given no indication of his location. However, Gaddafi's death might have been 'a fortunate by-product of our act of self-defence', according to a White House briefing. The aim was 'to make a point to Gaddafi' about retribution for state-sponsored terrorism.

A night-time, precision air strike was favoured to minimise risks from Libyan defences and avoid civilian casualties. This limited the choice of strikers to the F-111F and the A-6E TRAM Intruder, both of which were capable of identifying and hitting small targets at long range in darkness with precision-guided weapons. However, the number of A-6Es in-theatre was limited to just 20 aircraft split between two squadrons (VA-55 aboard CV-43 and VA-34 embarked in CV-66). Therefore, in order to carry out a single coordinated attack on several widely-spaced targets at once, F-111Fs were also required if political clearance from European countries could be negotiated.

As the planned attack was being mounted from a foreign country, British political sensibilities had to be allowed for. Prime Minister Margaret Thatcher, however, condoned the use of a UK base, despite strong opposition from her Cabinet, on the understanding that

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President Reagan's motives were self-defensive. Use of British bases could have been vetoed under a 1951 Anglo-American treaty. Her decision later brought her severe criticism from left-wing opinion in the UK. Unfortunately, Mrs Thatcher was alone in offering direct support, as the French, Italian and Spanish governments denied permission to overfly their territory (despite being terrorist victims themselves), and would not approve direct US anti-terrorist action.

The French president, Francois Mitterand, demanded full details of the mission for his defence chiefs to study, but his subsequent rejection added 2600 miles and up to seven hours to the mission, doubling its planned duration and increasing the tanker requirements. Four in-flight refuellings by numerous tankers managed by the 306th Strategic Wing would be needed. To simplify this process it was decided to include the tankers within the F-111 formation, one to each cell, thus saving crews from having to locate their fuel supplies. Without the usual help from air traffic control, radio communications or radar, the crews needed this more practical solution.

KC-10A Extender tanker crews give the photographer the thumb's up at Mildenhall prior to taking off for Operation *El Dorado Canyon*. On the outbound route the plan was for one F-111F to be positioned in the 'pre-contact' position behind the tanker, with another close to each wing, in an attempt to reduce the radar signature of each flight as 'seen' by air traffic control radars. A practice mission with two F-111Fs (flown by eventual *El Dorado Canyon* participants) and a KC-10A was flown across France to the Mediterranean on 18 March 1986 to test the vital communications links between the tanker force and US Navy vessels in the Mediterranean. Joint USAF/US Navy operations were unusual at that time (*via Jim Rotramel*)

Twenty-four KC-10As from three US bases were flown into RAF Mildenhall and RAF Fairford just before the operation, boosting the European Tanker Force KC-135 contingent and bringing the tanker total for the mission to around 30 aircraft. Included in this number was a specially equipped KC-10A command post in which the 48th TFW commander would accompany 'Puffy' flight of F-111Fs. The inquisitive media were told the extra tankers were needed for the regular NATO *Salty Nation* exercise that was currently underway.

Training had to be stepped up and normal weapons training detachments were used to fly larger numbers of F-111Fs direct from the UK to the Konya ranges they normally used in Turkey, recovering to Incirlik as usual. These flights provided many crews with their first experience of the KC-10A en route. Among them was F-111F 70-2389, which would subsequently become the wing's only casualty during *El Dorado Canyon*. Another more specific rehearsal took place on 21 March when two F-111Fs and an EF-111A, with KC-10A support, flew what Col Westbrook described as 'a mission to confirm that we understood the Navy's procedure for getting safely through the picket ships when exiting from Libyan airspace to return to the tankers'.

Orders to fly the real mission arrived on Col Westbrook's desk on 10 April, but it still was not clear whether this would be the anticipated strike by six aircraft on a single target or by 18 against three targets – the Bab al-Azizia barracks, the Murat Sidi Bilal terrorist training camp and Tripoli airport – using BSU-49s (Mk 82s fitted with Air Inflatable Retarders). The second option was then dependent upon over-flight rights being agreed. 48th TFW Director of Operations (DO) Col Tom Yax and wing CO Col Westbrook visited Ramstein to confirm the details, and they were surprised to hear that the larger force would be deployed to cause 'maximum visible damage' to the targets, even though the over-flight situation remained unclear. With only two days before takeoff the task had suddenly become far larger, and the small group of experienced crews selected for the six-aeroplane strike had to be increased significantly.

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F-111F 70-2387 'Lujac 23' from the 495th TFS commences its takeoff run from Lakenheath on 14 April 1986, also bound for Tripoli airport. It is loaded with 12 Mk 82 bombs with BSU-86 retarding fins and an AN/ALQ-131 ECM pod. Transferred to the 493rd TFS, this F-111F made the successful GBU-28/B 'Deep Throat' bunker buster attack at the conclusion of Operation *Desert Storm* in 1991 (*Jim Rotramel*)

Obtaining permission for relevant photographic target data from the US intelligence organisations was in itself difficult. The burden on planning staff was so heavy that at one point chief planner Lt Col Bob Pastusek took a top-secret message into Col Westbrook's office for his perusal and duly fell asleep in his chair after a few seconds as Westbrook read it through.

The final plan, received very late on 12 April, called for nine aircraft with GBU-10s to hit Gaddafi's Bab al-Azizia HQ, three to strike Murat Sidi Bilal with a similar number of LGBs and six to target Tripoli airport using Mk 82 AIRs. Planners at Lakenheath much preferred a six-aeroplane attack on the relatively small Bab al-Azizia site, three against the training camp and nine to hit the much larger and more open Tripoli airport objectives.

The prescribed larger assault on Gaddafi's compound would expose the aircraft to its heavy defences for more than four minutes. Lakenheath's preferences were overruled despite objections from Lt Col Pastusek and Col Bob Venkus, vice-commander of the 48th TFW and a vital figure in the planning. The nine-aircraft strike on Bab al-Azizia was demanded in order to maximise the damage to this conspicuous target. Attack plans had to be re-thought at very short notice, while avoiding confliction with the carefully coordinated routing established with the US Navy. The refuelling plan was also expanded.

The deviation from the original plan presented the Libyans, as Jim Rotramel put it, with 'a succession of single-file targets – ducks in a row. This prospect caused anxiety levels to skyrocket at Lakenheath'. The chances of precision hits by aircraft following those that had made successful bomb drops were greatly reduced, while the risk to the last three-aircraft cell ('Karma') was increased. To his great surprise 'Karma' leader (a highly experienced Vietnam veteran) was told by the Third Air Force commander, who saw the numbers problem but could not change his superiors' minds, that it would be permissible to abort his attack if the defences proved too effective. This complete reversal of normal USAF doctrine was shocking for 'Karma' leader. Clearly, the 'Liberty Wing' had to stick to the set plan even though it knew it had potentially fatal flaws.

'Remit 31' (F-111F 70-2390 of the 495th TFS) taxis out for takeoff as 'lead ship' for the Bab al-Azizia compound attacks. Its four GBU-10C/B bombs landed very close to Gaddafi's residence. This F-111F also led the 48th TFW(P) strikes on the first night of Operation *Desert Storm* (*SSgt Dale Woodward/USAF*)

THE MISSION

Task Force (TF) 60 naval attack squadrons, flying F/A-18A Hornets and A-6E Intruders from *Coral Sea*, were assigned to the Benghazi attack, while F-14A Tomcats and A-7E Corsair IIs from *America* supported the USAF attacks in the

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Tripoli area. Tactical command of the whole operation fell to Vice Adm Frank Kelso.

Both sets of targets around Tripoli and Benghazi were to be hit simultaneously in one-pass attacks, and if there was any doubt about target identity no bombs would fall. All aircraft had to have fully serviceable weapons systems – a severe Rules of Engagement restriction that would cause a reduction in the F-111Fs' success rate when a number of aircraft developed systems problems close to the target. ECM was provided by two VQ-2 'Batman' EA-3B Skywarriors (assigned to CVW-1) and five 'Harpo' EF-111A Ravens, the latter supplied by RAF Upper Heyford's 42nd ECS. The Ravens were supported by Marine Corps EA-6B Prowlers from VMAQ-2 Det 1 'Playboys', which boasted similar jamming systems.

Six A-7Es Corsair IIs from CVW-1's VA-46 'Clansmen' and a similar number of A-6Es from VA-34 'Blue Blasters' led the charge, hitting SAM sites with AGM-88A HARMs and AGM-45 Shrikes ahead of the F-111s. Four F-14A Tomcats from VF-102 'Diamondbacks' and VF-33 'Starfighters', launched from CV-66, deterred Gaddafi's fighters from the 'Tripoli Raiders', and the USAF formation's tankers were in position to meet the returning F-111s between Malta and Sicily. To ensure good coordination between the USAF and naval forces, an officer from the 48th TFW visited *America* to liaise with the TF-60 personnel on tactics and communications.

Targeting was extremely precise – single buildings, storage units, even the air-conditioning unit on the roof of 'The Leader's' HQ, were given as DMPIs within the Bab al-Azizia compound (the latter being added to the mission to the surprise of many). A target photograph showing Gaddafi's famous Bedouin tent within the compound had been marked with a large red triangle by the planners, who assumed that it would be off limits during the attack. Targets were heavily defended by Soviet SA-2, SA-3, SA-6, SA-8 and very effective French Crotale SAM batteries, with further SA-5 launchers at Sirte bringing the total number of static batteries and vehicle-mounted launchers to more than 500. Troops manning these weapons had anticipated an American attack for weeks.

F-111 and EF-111 crews were briefed on the afternoon of Sunday, 13 April. The late changes in the mission plan meant that there were delays in preparing and printing all the individual mission information packs. Crews for the Bab al-Azizia mission were given the option to pick their own radar off-set aim points (OAPs) from the available photographs taken from above Tripoli – a decision later regretted by the mission planners. In many cases these crew-picked OAPs were not distinct enough to give WSOs reliable cues. Also, a planning discrepancy misplaced by 60 miles the coordinates of the Mediterranean island of Pantelleria, ruling out its use as an OAP.

Twenty-four of the wing's most reliable F-111Fs were taken off Cold War alert duty and prepared for the mission, including six air and ground spare aircraft. The total of 18 jets allotted to the full mission still allowed for a number of technical problems, and previous experience from long F-111 sorties had shown that these were to be expected on such an extended flight. The aircraft had been designed to fly missions of two to three hours, and its avionics tended to 'drift' during flights of longer duration. The F-111F's TF30-P-100 engines offered a 50 per cent power increase over earlier versions, but their failure rate had been a factor in reducing

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the jets' availability in the year before *El Dorado Canyon*. Luckily, the only engine problem during the operation was a single afterburner failure.

As for the crews, one of the earliest F-111A pilots, Maj Charles Arnet, once said that 'a three-hour mission at low level left you pretty washed out'. The Libya crews had to survive a flight nearly five times longer, including an intense period over well-defended targets. In fact, six *El Dorado Canyon* crews would be forced to 'target abort' their attacks, and only 20 per cent of the 48 GBU-10E/Bs and 72 Mk 82 AIRs loaded onto the 45-ton F-111Fs that afternoon would hit their targets, including a third of the LGBs.

Thirty crews, sworn to absolute secrecy and mostly unaware of what had been planned for so long, attended the Lakenheath briefing and planning in the 494th TFS's briefing room. It was also attended by the USAF Chief of Staff, Gen Charles Gabriel, who warned the crews that they were going to war for the first time with 'everyone looking over their shoulder'. They were also reminded of the need for 'minimum collateral damage', even with block-busting 2000-lb bombs. Rather than *Salty Nation* loads of practice ordnance, the F-111Fs were loaded that afternoon with live bombs for this, the jet's longest-ever mission and the longest combat mission flown by a fighter aircraft. Sgt McNair-Foust was one of the weapons loading crew chiefs who prepared the F-111s. 'A lot of the crew members were writing notes on the bombs for Gaddafi. We knew that's where they were going'.

For the pilot of the F-111F call-signed 'Remit 33' the mission 'was going to contain a number of "firsts". I had never flown below 400 ft at night, yet our mission was planned for a 200-ft ingress to the target. I had never dropped live ordnance. I had never dropped heavyweight ordnance at night, I had never ejected chaff or flares and I had never flown with wartime settings on the ALQ-131 [ECM pod]. I had never refuelled "comm out" [in radio silence] and I had never refuelled from a KC-10A'. Despite all these challenges, 'Remit 33' would achieve some of the best results of the operation. None of the EF-111A crews had ever refuelled from a KC-10A either.

At the last minute a slight wind shift caused the tankers to take off to the east, while the F-111Fs took off in a southwesterly direction. This meant a re-calculation in the join-up times for the fleet, made by one of the most experienced F-111 crews whose WSO recalled, 'I decided to wait until the tankers were directly off our nose as they flew an arc around the base after takeoff from Mildenhall. This allowed us to take off and then

'Elton 42' (70-2396) was in the second wave of attackers for the Bab al-Azizia target, but all four 'Elton' F-111Fs were unable to make successful bombing runs due to various technical problems. Seen here in 1988 serving with the 493rd TFS, '396' was put to more effective use in *Desert Storm* (*Author's collection*)

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use the range and bearing provided by the air-to-air TACAN to show up on their "six o'clock" position. Things worked out fine, as we had fairly good visibility also'.

At sunset takeoff time (shortly after the watching media teams had left Lakenheath's boundary road), 28 tankers, the last one commanded by Col Walter Dill, left Mildenhall and Fairford at their maximum gross takeoff weight from 1713Z in two cells, using 'Debar' call-signs. The first cell was for 'Puffy' and 'Lujac' call-signed F-111Fs, targeting Tripoli airport – the longest part of the operation. The second supplied 'Remit', 'Elton' and 'Karma' (heading for the Bab al-Azizia complex) and 'Jewel', bound for the Sidi Bilal Training Camp.

Five Upper Heyford EF-111As (including an air-spare) awaited the F-111Fs, which had taken off 2 minutes 45 seconds after the tankers, with 30 seconds separation. They joined on their assigned tankers in cells of three (plus one spare for each cell), all in complete radio silence with IFF turned off and in a low, broken cloud-deck. On departure they passed over RAF Honington, narrowly avoiding a mid-air collision with four Tornados and also causing the diversion of several flights bound for London's airports.

The armada, reminiscent of World War 2 bomber formations, then headed out for the Bay of Biscay. 'Remit 33's' pilot recalled humming Wagner's '[Battle] Cry of the Valkyries' as he surveyed this 'awesome display of air power' heading into the sunset. Twenty F-111Es also took off from Upper Heyford on a scheduled *Salty Nation* exercise as a distraction for anyone monitoring the UK radar network with ulterior motives. Many F-111F crews found it difficult to believe that the mission was really happening, and they expected an imminent recall. Maj Jim Icenhour, with Lt Col Willy Kramer, managed the launch from Lakenheath's control tower. 'It was truly amazing. Twenty-four F-111s and six KC-135As with no flight plan, no radio transmissions and IFF turned off flew right by London, down to Land's End and out to sea, and no-one noticed!'

Two of the seven spare aircraft replaced F-111Fs with technical problems (an afterburner failure and a faulty PAVE Tack) and the others, apart from the spare EF-111A, returned to their bases as the formation cleared southwestern England. The first of four in-flight refuellings, plus a final pre-target top-off, occurred at 300 knots and 22,000 ft in darkness and still without radio communication – a 'first' for all the crews. For a few it was also their first encounter with the KC-10 tanker, although practice for most had been specially arranged during six-aircraft detachments to Incirlik in the weeks prior to *Eldorado Canyon*. In all, 1.23 million gallons of fuel were transferred during the operation. The seven 'mother' KC-10As were first refuelled by ten 'Dobby' KC-135As and 12 other KC-10As, transferring around three million pounds of fuel.

In close formation at night the F-111s had to be hand-flown, as autopilots were not sufficiently precise – this added to pilot fatigue. WSOs conducted repeated checks of their avionics and some took over the controls for a time to reduce their pilots' workload.

Fortunately, the armada's presence was not revealed by European coastal radars, except for a radar station in Italy that passed the information to Malta. From there it was transmitted to Libya, but with little effect – Tripoli's streetlights and airport runway illumination remained lit.

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A rare glimpse of a 'Karma' flight F-111F on the tanker. Although the out-bound flight required four aerial refuellings, most crews made more hook-ups to keep their tanks topped up. In radio silence, crews indicated their need for fuel simply by approaching the tanker with the F-111F's refuelling door open (as seen here). The KC-10As' TACAN capability was a useful navigational asset to the mission. Tankers from Seymour Johnson, Barksdale and March AFBs were involved in the operation (*via Jim Rotramel*)

The US carrier force was able to move into position unnoticed by the numerous Soviet spy-ships and reconnaissance aircraft. One radar operator on the North African coast saw the formation approaching, but he let his staff go home as they did not like Gaddafi and knew what was about to happen! However, the American media once again broadcast speculative information that gave a very detailed analysis of the naval aspect of the mission just before 70 aircraft launched from their carriers.

Coordination of the two attacks was vital in order to meet the crucial time-on-target (TOT) parameters, and problems soon arose when the F-111 force met strong headwinds rather than the forecast tailwinds. The lead tanker cell was also running ten minutes late as one KC-135A with equipment problems had to pass its fuel to a KC-10A (at a lower airspeed), rather than directly to its recipient F-111F. This in turn forced one of the 'Puffy' crews to break radio silence and transmit the cryptic message, 'We're late'. The time had to be won back through a pre-arranged short-cut 'timing leg' over Algeria and Tunisia that involved an increase in speed and an in-flight refuelling at an uncomfortably high airspeed.

The fourth, and final, refuelling 'plug' took place with the tankers entering a 30-mile long, north-south 'race-track' pattern between Tunisia and Malta, but some tankers continued to pass fuel to their F-111Fs while they turned at the base of the track to head north. This added further timing problems that could not be remedied without radio communications with the tankers. The crew of 'Puffy 11' 'left the tanker just as it turned north, and our final refuelling was done. The plan had been to get established in the refuelling track, get a final "top off" and then proceed south'. 'Elton 44' had to fly so far north to get enough fuel that it missed its attack time-slot completely and stayed with its tanker.

After taking maximum fuel, the other F-111s began a TFR descent ('blind letdown') to 1000 ft. The crew of 'Remit 33' had to do this manually as their radar altimeter did not provide the correct automatic signals. The Tripoli-area attackers, flying at 600 knots, passed Lampedusa Island some 160 miles from Tripoli. They had hoped to update their navigation systems by using two OAP landmarks on the island, including a tall radio mast. Unfortunately, the intelligence agencies in Washington, D.C. had not provided the 48th TFW with overhead photographs for this purpose, and the supplied map coordinates for the island were inaccurate. This final chance to check the aircrafts' navigation systems was duly lost.

A further complication arose when it became clear that winds over the target area were blowing in the opposite direction to the anticipated bearing. Crews had to compensate for a 20-knot headwind by using afterburner to maintain speed, particularly when their drag-inducing PAVE Tacks were extended. Crucially, the change in wind direction

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meant that smoke and debris from detonating bombs would be blown towards the approaching F-111s, obscuring the crews' DMPIs and interfering with PAVE Tack's vision.

The role of the 42nd ECS was crucial, as one crewmember explained;

'The primary plan was for the EF-111As to let down and lead the F-111Fs all the way in until we broke off our ingress to pop up to our close-in jamming orbits. It was thought that there was direction-finding equipment on the Libyan coast that would detect our TFRs as we approached the coast. During the weeks leading up to the mission all the EF-111A crews flew night-only sorties and practised hand-flying over water at 100-200 ft with our TFRs off and only the LARAs operating.

'After the last refuelling, and at the "push" time, the EF-111As were first to let down – we followed the same ingress routes as the F-111Fs. We used TFRs to let down to 200 ft and then calibrated our altimeters so that they read exactly 200 ft. We then shut off our TFRs and hand-flew, sometimes as low as 100 ft, all the way to our orbit. From my perspective this was the most challenging part of the mission, and it took a coordinated crew effort to make sure that we didn't hit the water.

'On the let-down from the tanker "Harpo 72" had a TFR or INS malfunction and the crew elected to abort and provide high-altitude stand-off jamming when the time came instead. Two EF-111As proceeded to the western, close-in, low-altitude jamming orbit off the coast of Tripoli, where the majority of F-111Fs were attacking, to provide coverage of their ingress and egress. The third ingressing EF-111A flew further east to a different close-in jamming orbit [to cover] the F-111Fs that were targeting the airfield.'

The Tripoli attackers approached on two slightly different ingress routes to avoid mutual interference by their TFRs, with odd-numbered call-signs (e.g. 'Remit 31') to the left and even numbers on the right. There was 45 seconds separation between aircraft as they approached at 200 ft, with wings swept to 54 degrees. The bombing parameters called for an approach speed of 600 knots to help eliminate the circular error, probable of the GBU-10. However, with such a drag-inducing ordnance load, afterburner was required to maintain that speed. All crews knew that they would have to identify and hit their targets during a single low-altitude, high-speed pass in darkness, surrounded by enemy anti-aircraft fire and relying entirely on their radars and PAVE Tack pods. 'Puffy 11's' WSO recalled, 'We were told to be within ten seconds of our assigned TOT or not drop at all'.

At this point 'Elton 41' (70-2403) withdrew with a PAVE Tack problem. The attack force approached its targets at around 600 mph exactly on time as the jamming aircraft blotted out Libyan radars and the 24 HARM and Shrike anti-radiation missiles from US Navy aircraft took out the guidance radars for many of the defending SAM sites. From 'Remit 33's' cockpit, 'The target run was a spectacle of sound and light. First were the Crotales, which skimmed the sea surface emitting a shower of sparks like cheap bottle rockets. The second was AAA, which included 20 mm ZSU "hoses", 50-60 mm "pom-poms" and intermittent explosions from a large-calibre gun. Finally, either "Remit 31" or "32" released a couple of flares that appeared like SAM plumes fixed on our windscreen. Our only reaction was to suck more air'. Their AN/ALR-62 radar-warning receiver emitted a, 'constant "do-dee-do-do" sound like a broken record all the way to the target'.

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F-111F 71-0893, awaiting its programme depot maintenance, displays the 'North Africa Campaign' sash applied to the tails of all 48th TFW aircraft after *El Dorado Canyon*. As 'Puffy 11' this jet made the most successful attack on Tripoli airport targets from a height of less than 500 ft, destroying two Il-76 'Candid' transport aircraft with Mk 82 AIRs and damaging several others. Its PAVETack imagery, shown worldwide on television, did much to demonstrate the success of the strike, although the other 'Puffy' and 'Lujac' aircraft inflicted only minor damage to helicopters and buildings. 71-0893 later flew with the 524th TFS at Cannon AFB, receiving the highly effective *Pacer Strike* upgrades (*Author*)

Many SAMs were fired but most were unguided after the destruction of their radar antennas. AAA batteries fired copiously but inaccurately, and the defences were clearly overwhelmed by the well-coordinated attack plan. Barrages of flares fired from ships in Tripoli harbour were a further distraction for the approaching 'Libya Raiders'. For most of the crews, facing live defences was a new experience for which no amount of simulation in training or rare *Red Flag* deployments could prepare them. To the few personnel with Vietnam experience it was all too familiar, but even more challenging.

F-111F 'Remit 31' (70-2390), a 495th TFS aircraft flown by the strike leader from the 493rd TFS, made the first individual run against Gaddafi's HQ. His TFR sensed a fault and began to initiate repeated 4g 'pull-up' commands, probably caused by interference from Libya's French Crotale SAM search radar which operated on the same frequency. Each transgression had to be over-ridden by briefly disengaging the TFR and pushing the nose back down. For the WSO, this process was compared to 'playing a video game on a rollercoaster – at night'.

Shortly afterwards the SAM tracking radars came under missile attack from A-7E and F/A-18A Suppression of Enemy Air Defenses (SEAD) elements. Pulling up sharply at a distance of 23,000 ft from the target, 'Remit 31' released four GBU-10E/Bs in a complex, precisely calculated toss manoeuvre, followed by a 135-degree wingover to depart the target area while the WSO continued to focus PAVE Tack on the target. He fired its laser for the last eight seconds of the bombs' descent so that they would pick up the laser energy from the target spot, using a pre-programmed code. One second before impact the pilot had to turn unexpectedly hard to avoid a ZSU-34/4 AAA radar that was tracking him and the laser broke lock. The bombs still impacted very close to Gaddafi's house, and 'Remit 31' headed out over the coast in a 120-degree banking turn.

'Remit 32' (72-1445) followed, and its WSO misidentified the offset points but realised the error and cancelled the bomb release with three seconds to spare. The crew headed out to sea to jettison their ordnance. At least three SA-8 SAMs were fired at 'Remit 32' as it departed, and the pilot reported seeing the fins and exhaust from one of them very near his canopy.

The third Bab al-Azizia attacker, 'Remit 33' (74-0178), experienced the same TFR problem as 'Remit 31', causing a 'sickening roller-coaster ride' that made the very experienced WSO's job almost impossible. At 18 seconds from its 'pull-up' point to attack the crew de-selected afterburner,

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re-set the wings to 54 degrees sweep and it was then a matter of 'Chaff, pull, pickle, chaff, "bombs gone", chaff and flare, wing-over' as they counted off the seconds to bomb impact during a 110-degrees left bank. 'Holding the aeroplane as still as I could for those 18 seconds in order to give my WSO a chance to find the target was the hardest thing I've had to do'. Smoke and debris from 'Remit 31's' ordnance obscured their aim, and in a final twist of fate their PAVE Tack malfunctioned seconds before they pulled up. Their bombs were 'tossed' using only radar aiming, but they landed squarely in the courtyard of the Gaddafi HQ, causing further damage.

As 'Remit 33' headed away with wings at 72 degrees sweep, an SA-8 SAM was launched at them unsuccessfully. They over-flew the offshore ship that checked them through the US Navy's air defences at 660 knots. 'During the debrief someone asked me why I flew at 660 knots over the ship. I replied, "Because it wouldn't do 661 knots"'.

The next striker, 'Elton 43' (70-2363), approached two minutes late at supersonic speed, but the Master Caution light illuminated with another indicator showing that very hot air was probably leaking into the main landing gear well, threatening to explode the massive undercarriage tyres and adjacent fuel tanks. 'Elton 43' pressed on nevertheless, but a complete electrical failure followed shortly afterwards. The crew headed north, using a hand torch to see their standby compass, in the hope of finding a tanker and managed to restore power from one generator. Later, they had to ask for another F-111F to 'torch' (dump fuel from its rear-fuselage vent into the afterburner, creating a 40-ft long flame) in order to show its position near a tanker.

PAVE Tack imagery from 'Puffy 11' shows Mk 82 bombs heading for a row of Il-76 'Candid' military transport aircraft at Tripoli airport. As the F-111F passed over the runway its PAVE Tack tracking head swung aft to keep the target in sight for the laser marker. Mk 82s can be seen falling to the right of the lower image. PAVE Tack entered service with the 48th TFW in mid-1982, and the initial plan had been to supply only sufficient pods for half the usual force of around 70 aircraft. However, the 1280-lb pod proved unpopular with F-4 units, who referred to it as 'PAVE Drag'. When fitted to the Phantom II it replaced the centreline fuel tank, thus drastically reducing the jet's unrefuelled range. Most of the 160 pods duly ended up with the 48th TFW as virtually standard equipment on F-111Fs (*USAF*)

The commander of the fifth F-111F for this target, 'Karma 51' (70-2413), decided to press home his attack despite the previous 'let-out clause' offered by the Third Air Force Commander. However, his TFR failed as he made his approach and he resorted to manual flying. His WSO had difficulty locating the correct offset point and selected one that was a mile further northeast than the correct location. When the bombs released he did not lase them with his PAVE Tack because his target did not appear on his VID. In fact, the bombs fell into a civilian area, damaging several foreign embassy buildings, particularly the French embassy, and killing a number of Libyans. Among them, fortuitously, was a leading Abu Nidal terrorist in a house close to the embassy that had been suggested as a possible target in the early planning stages. 'Karma 51' headed out to sea, lucky to escape a SAM that had locked onto the jet during its attack run.

Moments later 'Karma 52' (70-2389) vanished in unexplained circumstances. Crews in several aircraft saw a fireball hit the sea in the harbour area and many surmised that the F-111F had been hit by a missile. The escape module containing pilot Capt Fernando 'Nando' Ribas-Dominicci and his WSO Capt Paul Lorence had not deployed by the time the jet struck the water. The crash was witnessed by the pilot of

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'Remit 31' – 'It was a smear across the water. It reminded me of having seen napalm in Vietnam'. It was also visible from a 'Harpo' EF-111A;

'From our vantage point just off the coast of Tripoli we saw F-111Fs pass under us as most of them had their afterburners on as they ingressed at 550-600 knots. At the time Fernando went down I saw what appeared to be a fireball skipping across the water on ingress.'

'Karma 53' (71-0889), following moments later, saw a flash and fireball just ahead of them, and assumed it was an F-111 being hit by a SAM. They then had to turn sharply to avoid being hit by a SAM themselves.

It is possible that 'Karma 52's' ECM pod failed to protect them. Post-mission checks revealed that many of the AN/ALQ-131 ECM pods mounted under the aircrafts' rear fuselages for defence against missiles had failed due to the prolonged beating they had received from high-speed airflow during the mission. Indeed, parts fell out of many pods when they were examined later.

An autopsy after the return of the pilot's body to the USA via the Vatican in 1989 indicated that he had drowned in an unconscious state, although Capt Lorence's final fate remains unknown – only his helmet was washed ashore. Capt Ribas-Dominicci had been part of Lakenheath's elite Standardization and Evaluation section, and he had narrowly avoided having to eject from another F-111F the previous year when it suffered an undercarriage malfunction and then burst a main-gear tyre on landing, running off the runway.

Some of their colleagues felt that the decision to increase the Bab al-Azizia element to nine aircraft could well have contributed to the vulnerability of the final cell, and the consequent loss of 'Karma 52'.

As the last aircraft over Bab al-Azizia, 'Karma 53' had a PAVE Tack malfunction due to a failed generator during target approach, but continued in the hope that the problem could be resolved. Eventually, the crew had to turn seawards, dump their bombs and find their tanker. Of the nine aircraft originally allocated to this target only the first two had struck Bab al-Azizia, albeit with near misses, out of three that delivered any ordnance at all. The intention to obliterate the entire complex remained unfulfilled.

'Jewel' F-111Fs attacking the Murat Sidi Bilal training camp had similar misfortune. They picked up search radar emissions as they approached the coast and barrage AAA filled the air over their target. Even at their lowest

F-111F 71-0888 was 'Lujac 22', delivering Mk 82 AIRs on Tripoli airport. Its 492nd TFS/AMU markings have been removed here, and the seldom-used ferry tanks (for return to the USA) uploaded. The F-111F's TF30-P-100 engines gave it a clear 13,200 lbs thrust advantage over the F-111A/E when in afterburner. The turbofan engine developed less dry thrust than an equivalent turbojet, but offered better fuel economy (*USAF*)

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Four 493rd TFS F-111Fs stage a flypast for HRH Prince Charles during his visit to Lakenheath just after *El Dorado Canyon*. The furthest aircraft, 70-2386, was 'Jewel 64' during the operation (*via Jim Rotramel*)

TFR altitude of 200 ft radar indications were still evident, so they reverted to manual flight, approaching the target at 80 ft using the radar altimeter and hitting speeds of around 700 mph. This low altitude prevented WSOs from seeing coastal features (particularly a breakwater) that were their designated radar offsets. The lack of a navigation systems update from Lampedusa Island also complicated their task.

As 'Jewel 61' (70-2371) began its pull-up to toss its GBU-10E/Bs the PAVE Tack also showed no sign of the target or OAP. The bombs fell in an open field, quite close to a house where a British MP was staying. 'Jewel 62' (70-2383) also searched their radar displays unsuccessfully for the crucial breakwater but saw only the Libyan naval college complex in their PAVE Tack display as they pulled up. The WSO chose as his target a building that happened to be the kitchen. 'Jewel 63' (74-0177) achieved better results by climbing slightly so that the original target – a large covered swimming pool – was visible. Although smoke from the kitchen hit obscured the WSO's final lasing, later reconnaissance showed that the pool complex and several commando boats had been severely damaged.

The six 'Puffy' and 'Lujac' aircraft had, meanwhile, crossed the coast and turned northwest to complete their overland, low-altitude auto-TFR approach to Tripoli airport's military area, avoiding the defences. 'Puffy 12' (70-2416) had aborted just after its last tanker hook-up when its TFR malfunctioned. 'Puffy 11' (71-0893) led the way to the target, assisted by the well-lit civilian airport terminal as a visual reference. The aircraft's WSO recalled;

'We came in at an angle to the parking ramp because the OAP on our radar prediction was mis-plotted, causing the last-second correction. I had the pilot start turning the aircraft before I started lasing because I knew he would not get steering updates until the laser was processed. He was able to make the correction and level the wings only one second before the bombs came off. It was excellent flying.'

PAVE Tack showed five Russian-built Il-76 'Candid' transports, and the WSO verbally directed his pilot to them. They delivered 12 500-lb Mk 82s fitted with BSU-49/B AIR retarding tail-units, destroying two Il-76s with direct hits and two other aircraft with fragmentation impacts. Heavy cloud the next day prevented photo-reconnaissance by Mildenhall-based SR-71s and allowed the Libyans to clear away the evidence. The third 'Puffy' crew in 70-2394 had not switched to PAVE Tack and, using only radar and the mis-labelled OAP, dropped their bombs in an open area of the airport.

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All three 'Lujac' aircraft experienced difficulties. The first two, 'Lujac 22' (71-0888) and 'Lujac 23' (70-0387), mistakenly selected a radar target two miles east of the airport and had no time to re-direct their attack. They continued on over the coast and jettisoned their bombs. 'Lujac 24' (70-2405) made an accurate approach, but the aircraft's weapon release computer experienced a software problem that caused it to deposit its bombs into an orange grove more than a mile short of the airfield.

VA-55's A-6Es, hitting Benina airfield, had better fortune, leaving the target and several aircraft (including MiG-23s) in ruins. Six more Intruders from VA-34 hit Benghazi Military and Jamahiriyya Barracks, and also caused heavy damage to a MiG assembly facility. A-7Es and F/A-18As expended more than 30 AGM-88 HARMs protecting the Intruders.

As the F-111 strike force began the exhausting seven-hour return journey, it had to pass through the US Navy air defence barrier without being misidentified as a Libyan interceptor force in hot pursuit. This was done by giving each aircraft a set course, speed and altitude to follow as it flew over a destroyer designated as the 'delousing' ship to clear the F-111s through the Tomcat and Hornet fighter screen. The Libyan fighters did not attempt pursuit, partly because their air defence radars were still jammed by the American ECM aircraft.

Many of the F-111Fs were short of fuel, partly because they had used afterburner to make up lost time and cope with headwinds. The search for tankers became intense as pilots realised that some of their given vectors to refuelling tracks off Sicily were inaccurate, forcing them to use the tankers' TACAN or conduct a visual search to locate the KC-10s. 'Remit 33' was down to 2000 lbs of fuel by the time it joined a tanker after receiving help from 'Remit 31' and '32' – the latter jets had 'torched' to provide a position marker in the sky.

During this process the crews also gradually worked out which F-111s had not rejoined the departing ranks. The lead tanker for 'Puffy' element ('Debar 81') waited in vain for 'Karma 52', orbiting for an hour before heading home as dawn broke. Searches by P-3 patrol aircraft and a US Navy submarine were called off that evening, and by 17 April it was decided that 'Karma 52's' crew had been killed in action. In 'Puffy 11' and other F-111Fs, 'Many of us listened to President Reagan and others on HF radio during the return flight. It was unreal to hear them talking about what we had just done, and we were still hours away from landing'.

The Libyans claimed three US aircraft shot down, and announced that they had pulled the remains of an F-111F from the sea and sent it to the Russians. In fact, much of the debris they exhibited to the media came from a spent SAM booster stage. They also protested that 37 civilians had been killed, although falling SAM and AAA debris may well have caused some civilian casualties. Gaddafi and his family, paranoid about personal security, had escaped to a safe bunker just before the F-111s arrived, warned by a message from Italian Socialist leader Bettino Craxi. Gaddafi claimed that his adopted daughter had been killed, an assertion that was disproved after his downfall in October 2011. In the summer of that year his Bab al-Azizia compound was again visited by NATO attack aircraft, and this time they inflicted far more destruction on his military power-base.

The EF-111As' jamming activities had gone well. 'All of our jamming systems performed as advertised and everything we planned on seeing

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on our ALQ-99 scope appeared and was jammed automatically. When the last F-111Fs were "feet wet" we departed our orbits. EF-111As were the first jets in and the last out. The six-hour ride home was pretty sombre as we knew we had lost one F-111F – we all had friends on that mission'.

The main landing gear well problem that had forced 'Elton 43' to abandon its attack recurred on the return journey. The crew diverted to Naval Air Station Rota, in Spain, where, on approach to landing, their escort 'Elton 41' noticed four GBU-10E/Bs still on 'Elton 43's' pylons and suggested a diversion to jettison them over the sea – where they exploded spectacularly. A leaking hot-air pipe was repaired later in the day, allowing the aircraft to be collected by another crew, although the incident raised considerable attention amongst the international media.

Operations such as *El Dorado Canyon* and *Desert Storm* relied on the teamwork between F-111 strike flights, EF-111A Ravens and KC-135 or KC-10 tanker crews. Timing had to be accurate to the second, even over an unprecedentedly lengthy round trip like the Libya venture, so that F-111s could meet their tankers in the correct track, direction, speed and altitude in radio silence (*USAF*)

At Lakenheath the main formation completed the mission at 0810Z after 14 hours and 35 minutes airborne, although several crews had actually been sitting in their cockpits for 16 hours. Their return, in typical low cloud and rain, was anxiously awaited by the groundcrews, including Sgt McNair-Foust;

'None of us left until we saw the rest of the jets come back at about 0930 hrs the next morning. All the aeroplanes came back clean. All the bombs had been dropped.'

Armament crews and aircrew were presented with the solenoid connectors from the arming wires on their ordnance as souvenirs. The EF-111As recovered to Upper Heyford in good order, as a 'Harpo' crewmember recalled. 'As we were getting in our jets to take off I told my squadron DO I wanted a beer when I got back. When we landed the next morning he was standing there to greet us with a six-pack'.

'Remit 33', the third jet to land at Lakenheath, was marshalled to a 494th TFS Theatre Air Base-Vulnerability (TAB-V) shelter near the 48th TFW Operations building. 'As we were being winched back into the TAB-V we saw a caravan of cars pull up. Lo and behold, Gen Gabriel had chosen us to welcome back. Once the engines were shut down Gen Gabriel and his aide walked up to our jet. I removed my helmet and started gathering my other stuff, which included a pistol and ammunition, maps, code-books, check-lists, an empty lunch box, water bottles and two full "piddle-packs" [used for sanitary relief in flight].

'The "piddle-packs" were of the most concern. I didn't want to drop those babies, so I grasped them firmly in my right hand while toting all the rest of the stuff with my left. I carefully "un-assed" myself from the seat and descended the ladder. As soon as I turned round, there was the General with his right hand extended, ready to shake mine. Our eyes met during a moment of awkwardness for me, but one of comprehension for

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the General. He immediately reached with his left hand for the 'piddle-packs' and without missing a beat he swung them to his aide while shaking my now-free right hand. The first time I ever spoke to the USAF Chief of Staff was right after I handed him two bags of piss.'

The crew of 'Remit 32' had a similar experience, and a 'piddle pack' was dropped on the ground near the unfortunate General's feet, splashing his trousers.

El Dorado Canyon was the USAF's first major combat mission since Vietnam, and it was a particularly complex one by any standards. The operation revealed some equipment problems, and the amount of physical damage inflicted on the targets was less than the planners had intended. However, as President Reagan stated, 'The United States won but a single engagement in the long battle against terrorism. We will not end that struggle until the free and decent people of this planet unite to eradicate the scourge of terror from the modern world'.

Although Reagan's policy received little overt support in Europe, where further terrorist escalation was feared, it did bring about a stronger, coordinated European Community strategy in dealing with Gaddafi, echoed at the G-7 meeting of world leaders in May 1986. Gaddafi received public declarations of support from the USSR and Arab governments, but they privately welcomed the raid as a means of containing this unpredictable leader whose only true allies after *El Dorado Canyon* were Iran and Syria. In both countries small groups sympathetic to Gaddafi exacted their reprisals on American and British citizens.

Gaddafi, clearly shocked by the raid, and by the opposition to him that it engendered within his own country, toned down his overt support for terrorist activity somewhat until 1988-89, when Libya was implicated in placing terrorist bombs on two airliners – UTA flight 772 over Niger and Pan Am flight 103 over Lockerbie, Scotland – that killed no fewer than 430 civilians. Thereafter, he sought to reconstruct his relationships with the outside world, realising that *El Dorado Canyon* had been the start of a much tougher approach to terrorism by the USA and its allies. Despite histrionic objections to the operation from many countries Gaddafi actually found himself even more isolated, even by the USSR.

For the personnel at Lakenheath and Upper Heyford the following months were a time of heightened security, hostile European media responses and indefinite anonymity for those who had taken part in the operation as terrorist reprisals were thought to be more than likely. The most credible local threat was a plan by a Libyan pilot, under training near Oxford, to crash a light aircraft onto a US base. Fortunately, his plot was detected in time and he was deported.

Follow-up attacks on Libya, using revised tactics and improved GBU-24 and GBU-15 guided weapons, were studied and practised. Col Westbrook nominated the 48th TFW for the Presidential Unit Citation to recognise its achievement but the USAF wanted to award it only to those sections of the wing that it thought were directly involved in the mission. Protesting that the success of the operation had depended on the entire 'Liberty Wing', Col Westbrook withdrew the nomination. Ironically, however, on 7 September 1986 the Secretary of the Navy, John F Lehman, presented the 48th TFW with the Navy Meritorious Unit Citation – the first time this had been done on an inter-service basis.

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DESERT STORM

The political and military success of *El Dorado Canyon* did much to remove lingering doubts about the F-111's effectiveness as a long-range striker, and it was therefore a natural choice for the frontline five years later when Coalition action against President Saddam Hussein was required. F-111Fs that had performed the Libya mission flew over the desert at night once again, armed with guided munitions that had been improved since the action against Gaddafi. Paveway III guidance kits increased accuracy, particularly at low altitude, and BLU-109 penetrating warheads enabled hardened targets like aircraft shelters to be destroyed.

Over Iraq, the F-111's success rate in removing Saddam's military capability was the highest of any of the aircraft involved, but this achievement was sidelined by the government and media in favour of the attributes of newer acquisitions like the F-117A and the F-15E Strike Eagle that required political support for funding. However, the public and media response to the F-111's efforts was far more positive than any it had received previously, and not a single example was lost in combat.

The B-1B Lancer, replacement for SAC's FB-111A force, was unavailable for *Desert Storm* as it was configured for nuclear strike only. The F-15E Strike Eagle, the F-111's intended successor, was certified to carry only 'dumb' bombs when it deployed to Oman, 250 miles from Iraqi territory, in preparation for the 1991 desert war. Weapon release problems had been encountered in test drops by the 422nd Test and Evaluation Squadron (TES) at Nellis AFB. However, a combination of a handful of hastily acquired AN/AAQ-14 Low Altitude Navigation and Targeting Infrared for Night targeting pods and advice and assistance from crewmembers with F-111F experience meant that the F-15Es were able to start delivering LGBs about a week after hostilities began.

In January 1991 the 48th TFW's F-111Fs were an obvious choice as highly capable, precision night-strikers in the mix of more than 1000 aircraft and hundreds of Tomahawk land attack missiles (TLAMs) pitted against Iraq's elaborate defences. EF-111As were also essential to protect the incoming air armada with their comprehensive AN/ALQ-99E semi-automated jamming systems, running ahead of the force at high speed to set up orbits from which

Mk 82 AIR bombs fall neatly away from F-111F 72-1443 (a *Desert Storm* participant) while its PAVE Tack continues to track the target, in this case on the Bardenas Reales range while the 494th TFS was at Zaragosa air base, Spain. The 'ballute' retarding system was originally designed for nuclear stores (*USAF*)

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Inspection for combat damage was one of the first tasks performed by maintenance personnel upon the jet's return from a mission. Here, the 48th TFW flagship (72-1448 *Miss Liberty*) gets a practice 'once over' during a 1988 integrated combat turnaround (ICT) by the 493rd AMU. A *Desert Storm* flyer, '448' bears the colours of the four Lakenheath squadrons and the *El Dorado Canyon* streamer on its tail fin (*Author*)

they saturated the enemy radar positions and often triggered off storms of AAA, which reduced as the attackers approached.

Unlike the fluid and ambivalent Vietnam situation, the F-111 squadrons and the Coalition forces had a clear and precise objective – the liberation of Kuwait from Saddam's brutal invasion forces, which had entered that country with almost 1000 tanks on 2 August 1990. F-111s and the 18 EF-111As under 48th TFW (Provisional) control (12 from the 390th ECS at Mountain Home AFB and five 42nd ECS examples from Upper Heyford) were a vital part of the 'thunder and lightning of *Desert Storm*', as its histrionic Commander-in-Chief Gen Norman Schwartzkopf liked to describe his intricately planned assault. Later in the campaign they would help to fulfil JCS Chairman Gen Colin Powell's aim of 'leaving those tanks as smoking kilometre signposts all the way back to Baghdad'.

When the USA began Operation *Desert Shield* on 2 August 1990, principally to keep Iraqi forces from entering Saudi Arabia following the seizure of neighbouring Kuwait, the 48th TFW 'Liberty Wing' prepared 18 F-111Fs from its 492nd and 494th TFSs for deployment. It loaded the aircraft with GBU-24s and sent them (with 'Cochise' call-signs) on 25 August to Taif AB, in Saudi Arabia, some 525 miles from the Iraqi border. Their ordnance was often decorated with unofficial slogans like 'Baghdad or Bust' and 'Central Heating by GBU'. Fourteen more followed on 25 September, another 20 on 29 November and ten on 11 December. The total stood at 67 by mid-January 1991, leaving a token contingent of F-111Fs for training at Lakenheath despite the majority of the base's 'Aardvark University' instructors from the 495th TFS having also deployed.

Initially, the digital F-111Ds of the 522nd TFS/27th TFW at Cannon AFB were also scheduled to fulfil the task (albeit without PAVE Tack capability, as the pod was not compatible with the aircraft's multi-sensor cockpit displays), but two squadrons of F-15Es were eventually sent instead.

Re-designated the 48th TFW(P) once in Saudi Arabia, the F-111F wing and its four maintenance units (AMU) were housed in spacious, superbly lit hangars that improved on the chilly, sepulchral hardened aircraft shelters (HASs) at UK bases. The AMUs, called 'Freedom', 'Justice', 'Liberty' and 'Independence', did not correspond directly with the Lakenheath AMUs, and they were reorganised at least once prior to hostilities commencing.

The first batch of F-111Fs from the 492nd and 494th TFSs blasts off from Lakenheath on 25 August 1990, pre-loaded with the GBU-15s, GBU-24s and GBU-10s that they took to Taif air base in Saudi Arabia so that they would be ready for an instant response to increased Iraqi action (*Bob Archer via Jim Rotramel*)

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Very few crewmembers had previous combat experience, and each crew completed around 20 training missions to become combat-ready. Continuation training used the Askr bombing range near Taif, and on 11 October 1990 F-111F 'Cougar 41' (74-0183, the last jet to receive PAVE Tack modifications) and its crew, Capts 'Art' Reid and Tom Caldwell (WSO), were lost there during the post-release manoeuvre following a practice Paveway III delivery. They came from Col Pahl's squadron;

The 48th TFW deployed 19 F-111Fs of the 492nd and 494th TFSs from RAF Lakenheath to Taif, Saudi Arabia, on 25 August 1990. By 17 January 1991 there were 67 F-111Fs in place for Operation *Desert Storm*. F-111Fs 70-2390 (seen here on the eve of departing for Taif) and 72-1448 took turns as the 48th TFW flagship during the 1980s and early 1990s. 70-2390 led the attacks on Libya in 1986 and the opening mission of *Desert Storm* (*DVIC*)

'It was the only crew we lost during the whole campaign, and they just flew into the ground. Both were very experienced guys. I just think they could have been tired. Things had been going at quite a pace and everyone makes mistakes.'

As Jim Rotramel observed;

'One design deficiency with all F-111s was that during the weapon delivery phase the WSO was focused on the radar scope, and he had no reference to the aircraft's altitude or attitude to back up the pilot if he became distracted. This was a contributing cause to a number of fatal accidents over the years.'

In the very early morning of 17 January 1991 the opening act of the aerial drama conceived six months before by Col John A Warden (who headed up the USAF's Directorate of Warfighting Concepts in the Pentagon) was refined into Operation *Desert Storm*. It included two EF-111As as jammers for a 'gorilla package' of F-15Es and RAF Tornados that struck Iraqi Scud missile emplacements in the west of the country.

Meanwhile, 415th TFS F-117A Nighthawks opened the bombing campaign at 0250 hrs with GBU-27 attacks on the KARI system air defence centre at Nukayb, followed by 12-aircraft assaults on the Iraqi Air Force (IrAF) HQ and communications targets in the Baghdad area. Some of the stealth fighters were flown by former F-111 crewmembers like Maj Greg Feest, who had previously been a WSO with the 20th TFW until 1982 – he released the first bomb of the campaign – and hand-picked ex-FB-111A commanders like Maj Mike Mahar.

Infra-red imagery of pin-point accurate strikes on the IrAF HQ building by Capt Mark Lidstoem or the Al Karak building ('AT&T telephone centre') by Majs Jerry Leatherman and Paul Dolson (who dropped GBU-10s) conveyed to the world the deadly effect of LGBs. Their missions were disguised by their aircrafts' stealth characteristics but also by blanket jamming from EF-111A Ravens. BQM-74C Chukar target drones and tactical air launched decoys (TALDs) drew off the SAMs and AAA. Effective Coalition air superiority was attained within minutes of the first ordnance falling, and total air superiority was reached after two days.

Col Tom Lennon's 48th TFW flagship *Miss Liberty II* (70-2390 'Remit 31' in *El Dorado Canyon*) had been the first F-111F to arrive at Taif, and it led the wing's first night assault. The jet went on to complete 29 combat

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An ear-shattering takeoff by F-111F 73-0715 of the 48th TFW(P) from Taif air base at the start of a training mission during *Desert Shield*. This jet was rebuilt in 1980 after a landing accident at Lakenheath on 12 December 1979. The aircraft had damaged its main undercarriage during takeoff, leaving the crew with little option but to attempt an arrested landing. The pilot was informed (incorrectly) that his hook had missed the arresting cable and he applied full power for a 'go-around', but the heavy aircraft was then abruptly pulled back onto the runway (*USAF*)

sorties over Iraq, striking 58 targets. 'I was assigned to go against a large hangar', explained Col Lennon. 'We found the target and launched our weapon [a GBU-15 glide-bomb] from a rather long stand-off range'. His six F-111Fs, out of 53 launched that night, devastated Balad airfield with LGBs and CBU-87 combined effects munitions, exiting the target safely at an altitude of 200 ft despite heavy AAA opposition.

Another 48th TFW pilot, Capt Matt Warren, recalled feeling apprehensive as he crossed the border into Iraq at 600 mph;

'At first it was kind of tense as we picked up Iraqi search radar emissions. They knew we were coming. We approached at low altitude, climbed to 5000 ft, dropped a bomb and continued to "lase" as we turned away to get back to low level. This attack profile gave us a better "look angle" into the target and a little more energy to the bomb.'

Later that night, when almost 700 aircraft flew over Iraqi territory, a second wave of 40 F-111Fs struck several of the country's 65 huge airfields in five group attacks – Jalibah, H-3, Salman Pak and Ad Diwaniyah, in Iraq, and Ali-Al-Salem and Ahmed Al Jaber, in Kuwait, were all targeted. Defences at Ali-Al-Salem were unusually heavy, and three GBU-24 drops had to be abandoned. However, Lt Col Dennis Ertler and WSO Capt Keith Zuegel kept their laser trained on the door of a HAS and demolished it with GBU-24s, despite having three SAMs pass close to their aircraft. Both were awarded the Silver Star. Chemical weapons storage areas at the massive H-3 complex were demolished by

Col Tom J Lennon straps into his F-111F to lead the first deployment to Taif on 25 August 1990. Born in Honolulu, Lennon entered the USAF in 1966 and flew the F-4 Phantom II from 1968 to 1974, during which time he completed 390 combat missions in Southeast Asia. After four years flying the F-15 Eagle, he commanded the 48th TFW from April 1989 through to July 1991. For *Desert Storm* he warned his pilots that the 'biggest threats are hitting the ground or running out of gas' (*DVIC*)

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The slanted flanks of Iraq's hardened aircraft shelters (HAS) were designed to repel bombs, but F-111F crews found that a vertically dropped pair of LGBs would penetrate the flat roof area. This wrecked structure was at Ahmed Al Jaber air base, in Kuwait, which had been occupied by Iraqi forces following their invasion in August 1990. French-built HAS structures at Ali-Al-Salem air base, also in Kuwait, were similarly attacked by Coalition aircraft, as were many shelters on the huge Iraqi bases. At the latter sites, the 'hardest' Yugoslav-built examples boasted concrete and sand walls ten feet thick, with 24-in thick steel doors (*DVIC*)

GBU-24A/B LGBs from six F-111Fs, but several pilots were distracted by 'lock-ons' from enemy fighter and missile radars and had to take evasive action rather than guiding their LGBs.

An attack on Saddam's Tikrit summer palace and estate by four 'Redskin' flight F-111Fs, flying at an altitude of 400 ft at 540 knots, with support from two EF-111As, caused considerable damage when a GBU-10 was guided through a window into the roof. Another GBU-10 missed, one F-111F aborted with systems problems and a fourth had to abandon its attack to evade a MiG-29 that attempted to engage all four of the jets in turn before they outran it in a 70-mile tail-chase. 'Redskin' flight dropped to an altitude of 200 ft and raised their speed to 600 knots to throw off the MiG, but it was one of very few occasions when an attack was interrupted by enemy fighters. Although they were operating as a flight of four, the F-111Fs used their normal 'single-ship' attack profiles, with 1.5 minutes separation between aircraft.

EF-111As, of which five left Upper Heyford for Taif on 21 December 1990, were involved in one of the first clashes with Iraqi fighters during the early hours of 17 January. The engagement resulted in the first loss of an IrAF aircraft in *Desert Storm* and what, for a time, was considered the F-111's only MiG kill, although it was subsequently thought that the enemy jet was downed by an F-15C pilot. Capts Jim Denton and Brent Brandon (WSO) were pursued by an Iraqi Mirage F 1EQ while

A 492nd TFS F-111F loaded with GBU-10 Paveway II laser-guided bombs based on the 2000-lb Mk 84 with an MAU-169 tail control group of extending fins and a KMU-351 seeker head. Average accuracy of around three feet was regularly achieved by the weapon, which began service in 1977. It even scored an air-to-air kill in February 1991 when an F-15E Strike Eagle used one to knock down an IrAF Mi-24 'Hind' helicopter during *Desert Storm*. AIM-9P Sidewinders were carried on LAU-105 adapters attached to the pylon. Mixed loads of GBU-24s and GBU-10s, or GBU-10J/Bs with BLU-109 penetrating warheads and GBU-10E/Bs with Mk 84 warheads, were sometimes used in *Desert Storm* (*Author*)

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GBU-24/B Paveway IIIs on a 494th TFS F-111F. A more subtle microprocessor autopilot in the guidance and control unit, with a bigger laser seeker head and enlarged tail fins, replaced the simple 'bang-bang' control logic of the Paveway II and made the weapon more suitable for low-altitude attacks. In *El Dorado Canyon* it might have enabled greater accuracy but it was in short supply and only one squadron (the 494th TFS) had experience with it. The GBU-24 used the same Mk 84 basis as the GBU-10, and in the late 1990s a GPS-aided guidance package was added, overcoming many of the problems with poor weather or obscured target visibility encountered by F-111F crews in *El Dorado Canyon* and *Desert Storm* (*Author*)

they were on a medium altitude stand-off jamming orbit. The Iraqi pilot fired a missile at them, which was decoyed by chaff and flares from the Raven. Denton dived to minimum TFR altitude and made a tight turn while the Mirage ploughed into the desert in an intense fireball behind them.

Forty F-111F sorties were launched during the night, the 48th TFW(P) sending in large strike packages in an attempt to reduce the concentration of defensive fire being shot at individual aircraft as they targeted key IrAF airfields – an important lesson learned from *El Dorado Canyon*. Six jets made a particularly successful attack on Mudaysis air base, pulverising all but three of the airfield's 23 aircraft shelters with GBU-24s dropped from 20,000 ft and destroying a number of their resident fighters.

The Taif routine was soon established, with one F-111F wave taking off at mid-evening and another at around 0130 hrs, meeting six tankers near the Saudi border – four F-111Fs per tanker. Crossing the border, with ECM pods switched on and formation lights off, the aircraft then approached their targets in groups of eight to twenty from various directions to confuse the defences. Some missions entered Kuwaiti airspace, Lt Col Tommy Crawford, for example, leading a six-ship attack on aircraft shelters containing Scud missiles at Ali-Al-Salem airfield. He described meeting a, 'solid wall of AAA' as they ran in at 1000 ft. 'It seemed like every 50 yards there was a guy with a gun shooting at us, so we crossed the border at 200 ft and that was where we stayed'.

During the first two nights ingress routes to the target were initially flown with TFR, but barrage AAA often forced crews to climb and descend repeatedly to avoid it. Some elected to stay at 20,000 ft, which also reduced fuel consumption and pre-strike aerial refuelling. One strike formation did not inform the tankers of this change of plan, obliging the KC-135 crews to dump very large quantities of fuel in order to reach safe landing weights.

On their return, several F-111Fs had to divert to Jeddah air base due to thick fog at Taif (no surprise to crews who were used to East Anglian weather), including one jet from Col Lennon's formation that had a hung GBU-24/B bomb. Others had to use emergency airfields due to fuel starvation (as a result of flying lower and faster than anticipated to avoid the defences) or seek aerial tankers, but all returned safely. F-111F 70-2384 was slightly damaged, however, during a pre-strike collision with its KC-135A tanker and had to be replaced by 70-2369. Minor small-arms damage was noticed on two jets and, as previously mentioned, four were successively engaged by one of Saddam's elite MiG-29 pilots but they managed to out-distance their pursuer at low altitude and prevent him from attaining a radar lock on any of them.

As dawn broke on 17 January a force of 32 F-16Cs, with support from F-15Cs, F-4G *Wild Weasels* and four EF-111As, hit Al Taqaddum airfield. A typical strike package had F-15Cs sweeping ahead to neutralise enemy fighters, F-4G *Wild Weasels* with AGM-88 HARM missiles to suppress anti-aircraft missiles, two EF-111As following them to provide jamming and then the strike flights of F-111s and F-16s. Strike packages were

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***Miss Liberty* (70-2390) leads the flagship F-111Fs of the 494th TFS (Lt Col Ken Combs' 74-0178, formerly 'Remit 33' in *El Dorado Canyon*) and 493rd TFS (70-2403, assigned to Lt Col Mike Malone). The fourth jet in the formation is EF-111A 66-0014 of the 390th ECS, which was also assigned to the CO of the 366th TFW. This photograph was taken over the desert wastes of Saudi Arabia during a *Desert Shield* acclimatisation sortie. The Taif-based 48th TFW(P) AMUs did not correspond directly to the Lakenheath squadrons. By the end of the conflict it was possible to see aircraft with a squadron insignia from one unit, a fin cap with a different squadron's colours and main landing gear wheel hubcaps in the colours of a third squadron (*USAF*)**

initially ordered to remain above 15,000 ft to avoid AAA of less than 57 mm in size, but F-111s and F-15Es were allowed to go lower. On the first night of the war 93 per cent of the LGB drops were made by F-111Fs and F-117As, and for the rest of the campaign all Nighthawk sorties, 99.6 per cent of F-111F operations and 94 per cent of those by F-15Es were made in darkness.

Another F-111F sortie against Balad airfield was disrupted by a MiG-29 and AAA on the night of 17/18 January, while a 20-aircraft shelter-busting mission, attacking at altitudes between 12,000 ft and 20,000 ft, had to abandon its lower level drops because of intense AAA. The last aircraft off the target released its GBU-10s and then received Radar Homing and Warning Receiver indications that a MiG-29 radar had locked onto it at around 20,000 ft. The time-honoured tactic of diving for the deck with wings swung back worked once again, although the MiG's radar lock was held for more than 30 seconds as the F-111F dispensed countermeasures to defeat it.

20th TFW

During the early hours of 18 January a second F-111 force was introduced to the conflict when 18 of the 22 E-model jets from the 79th TFS/20th TFW, based at Incirlik AB, in Turkey, took off on what the Turkish government announced as a 'night training exercise'. Fortuitously, elements of the 20th TFW had been taking part in a routine weapons training detachment at Incirlik, some 300 miles from the Iraqi border, when *Desert Storm* commenced. The F-111Es duly hit four radar sites in the northern part of the country, knocking out seven radar installations with Mk 82 AIR bombs from 200 ft approaches. These attacks left northern Iraq's radar warning network inoperative.

The following night the Kirkuk nuclear research buildings were targeted, followed by troop concentrations, SAM and AAA positions and communications centres, although the heavy defences in northern Iraq obliged the F-111E formations to bomb from 25,000 ft. At the lower altitudes favoured for most F-111 attacks AAA was by far the worst threat, but Iraqi gunners, like their equivalents during the Vietnam War, tended to fire at the howling noise of the jets, which usually meant that their shells passed well behind the speeding fighter. Their luck would change if a pilot had to use afterburner for acceleration or became back-lit by fire or explosions, giving the gunners a target to aim at. This had happened during the strikes on the Bab al-Azizia complex during *El Dorado Canyon*. Barrage fire – a thick

RIGHT
The three strike components of the *Proven Force* 7440th Provisional Wing at Incirlik were 20th TFW F-111Es, with their EF-111A jammers, and USAFE F-16Cs. Seen here in 79th TFS markings and bearing the pre-war nickname *The Other Woman*, F-111E 68-0040 flies with EF-111A *'Let 'Em Eat Crow'* (67-0034), which took part in *El Dorado Canyon* and also deployed to Incirlik. The F-16Cs came from the 52nd and 401st TFWs, rather than the 50th TFW as seen here. This F-111E was the last example to be lost in an accident when it crashed during a practice single-engined approach to Cannon AFB in 1995 (*DoD*)

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A full load of Mk 82 AIRs on the 77th TFS's F-111E 68-0007. These bombs were quick to assemble, and they could be dropped at low altitude with the aircraft making its best speed (*Author*)

curtain of fire projected ahead of an aircraft's anticipated course – was harder to avoid, and pilots had to balance the risk of taking a hit against the chances of losing the target heading by manoeuvring.

One mission was aimed at the hydro-electric power station attached to a dam on the Tigris River. Fired on by numerous AAA emplacements and detected by SAM radars, four crews approached the target, several of them at 300 ft on TFR. Each aircraft dropped 12 Mk 82 AIRs from BRU-3A/As (mounted on the outboard pylons, with single Mk 82 AIRs on the inboard pylons), causing severe damage to the electrical transformers. Maj Mike Sweeney, WSO in the lead F-111E, was awarded the DFC for his part in the mission, which denied electrical power to the city of Mosul.

Aircraft assigned to *'Desert Storm North'* (officially, Operation *Proven Force*), including the 22 F-111Es of the 20th TFW, were controlled by the composite 7440th Wing (Provisional). They had been kept waiting at Incirlik for a day while the Turkish President, Turgut Ozal, persuaded the reluctant elements in his National Assembly to allow US aircraft from 15 units to use the base against Iraqi targets. F-111Es from the 79th TFS had been joined at Incirlik by a contingent of six 42nd ECS EF-111As from Upper Heyford on 17 January. Here, they flew alongside USAFE RF-4C, F-15C and F-16C units, with their attendant tankers, adding another 100 daily sorties to the Coalition effort.

A further addition to Brig Gen Lee A Downer's 7440th Wing (P) was planned as a way of enabling its F-111Es to benefit from the same PAVE Tack targeting accuracy as the Taif F-111Fs. Four PAVE Tack-capable F-4E

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Phantom IIs from the 3rd TFW at Clark AB, in the Philippines, arrived at Incirlik on 20 February, but their targeting pods were delayed in Hawaii by bad weather and they flew flak suppression sorties instead until the PAVE Tack equipment arrived. The plan was to load F-111Es with GBU-24s for a toss-bombing strike on northern Iraqi airfield facilities, with two F-4Es providing 'buddy laser' targeting for four jets. However, the ceasefire on 3 March prevented any such missions being flown, although a number of trial flights were undertaken on the Konya range in Turkey.

CBU-71/Bs mounted on an F-111F in 1987. The canisters opened at the seam-line visible on their upper surface (*via Jim Rotramel*)

By the end of *Desert Storm* the Incirlik F-111E and EF-111A units had flown 708 combat sorties, targeting fuel and ammunition dumps, airfields and rail transport, and had contributed to the destruction of 95 per cent of the country's power generation grid.

Missions were launched as complete packages of 50 to 70 aircraft, including eight, twelve or sixteen F-111Es and two or three Ravens. All aircraft assigned to the mission would take off during a hectic 30-minute period from the crowded Incirlik base after a mass briefing by the mission commander – usually a senior F-111 pilot or WSO. Typically, three targets were hit each night by a flight of four F-111Es per target. Missions from Turkey tended to be slightly shorter than those flown from Taif, with two-hour sorties over the north or flights of up to four hours to objectives in the Baghdad area, which were hit on several occasions.

As previously noted, the 79th TFS had been rotated to Incirlik on a weapons training detachment in late November 1990, replacing the 55th TFS which had been there on an identical three-week deployment that was extended to eight weeks when war loomed. Four 55th TFS F-111Es and ten crews went out to join the 79th TFS 'Tiger Squadron' on the eve of *Desert Storm*, and personnel from this unit eventually outnumbered pilots and WSOs from the 79th TFS as crew rotation progressed.

Late-war targets for the 20th TFW's 4714 tons of ordnance included railway marshalling yards, oil refineries and communication centres. Much of the wing's bombing took place from higher altitudes, where, without the F-111F's precise PAVE Tack and LGB combination, a load of 14 Mk 82 AIRs could impact a 1000-yard strip of terrain. However, the accuracy achieved with this type of area radar-directed bombing was reduced at high altitude, as the F-111E's radar was optimised for low-altitude attacks. For some missions eight CBU-87 Combined Effects Munitions or CBU-89 Gator canisters were loaded, or occasionally Mk 84s.

55th TFS F-111E 68-0026 still displays 23 *Proven Force* mission markings in September 1993. This hardworking jet had clocked up 5868 flight hours by the time it was retired the following month. Beneath the nose are projections housing a KB-18A strike camera and the triangular AN/ALR-62 Compass Sail antenna, with a UHF antenna just ahead of the nose-gear doors (*Author*)

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F-111E 68-0069, with 22 Operation *Proven Force* missions marked up beneath the windscreen, is seen on short finals at RAF Upper Heyford soon after its return from Incirlik. Nicknamed *The Wild Hare* in 1988, the aircraft had completed 5940 flight hours by the time it was retired in November 1993. *Proven Force* F-111Es flew up to three missions daily against Iraqi radar installations and nuclear, chemical and biological weapons plants from Incirlik with the 7440th Wing (Provisional) (*Chris Lofting*)

Indeed, the latter weapon was used for the last F-111E mission of the war when 14 aircraft each dropped four of the 2000-lb bombs.

That final mission also saw the combat debut of F-111E 68-0050, the first Upper Heyford aircraft to pass through the avionics modernisation programme (AMP). This was a derivative of the SAC updates for its FB-111As, including two multi-function displays, a better central display unit for the radar tied to a ring-laser gyro and a Navstar GPS. Improved self-protection was provided through a separate modification with the Tracor AN/ALE-40 chaff and flare dispenser, which replaced the Vietnam-era AN/ALE-28 set. The overall result was greatly improved navigation and weapons delivery for all 'AMPed' F-111s. High altitude bombing accuracy was greatly improved too, demonstrated by bombing trials on the Jurby range off the Isle of Man.

Originally intended for the entire F-111A and F-111E fleet, AMP was delayed and eventually limited to 50 F-111Es and EF-111As as the end of the Cold War signalled the impending drawdown of the fleet. However, 68-0050, temporarily re-finished in 'Gunship Gray' paint with a 'Euro Grey' radome, received a black bomb-score mark beneath its cockpit to signify participation in the last Gulf War mission from Incirlik. Post-war, it reverted to 'Vietnam camouflage' for its latter days at Upper Heyford after crews complained that the overall grey scheme made it too hard to see in the air. Later, once assigned to the 20th FW at Cannon AFB, it was painted grey again! For the F-111F, the equivalent of AMP was *Pacer Strike*, but this upgrade was not completed before *Desert Storm*.

IrAF FIGHTER THREAT

19 January brought unwelcome evidence that the Iraqi fighter force was still active despite eight losses on the first night of the war. Two EF-111As were on station near Al Qaim for an F-15E strike on Scud emplacements near the town when, as they set up their jamming orbit ahead of the 12 Strike Eagles' arrival, the Ravens came under supersonic attack from a MiG-25PD that had managed to slip through the F-15C fighter screen and fire three R-60 air-to-air missiles. Both EF-111As evaded the missiles by using the standard tactic of a steep descent to low altitude, but they had to leave

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the F-15E strike unprotected (its two F-4G *Wild Weasels* were delayed due to confused instructions) and one Strike Eagle fell to an Iraqi SAM.

Two MiG-25s (faster than the F-15C) and two MiG-29s were shot down that day, but another 'Fulcrum' fired a missile at an F-111F flown by Capts Mike McKelvey and Mark Chance as the crew waited their turn to bomb Al Habbaniyah airfield. McKelvey and his wingman crew, Capts James McGovern and Will Ward, had earlier been reduced to a two-aircraft attack after their leader abandoned the mission following a minor collision with their tanker. The deputy lead departed a short while later with mechanical problems. The two remaining F-111Fs reached their Baghdad area target before the F-15C CAP was on station, but they pressed on with the attack nevertheless. They successfully used chaff and a vertical break to divert the MiG-29's missile, which exploded harmlessly in the clouds. The two F-111Fs severely damaged the Iraqi runways and both crewmembers were awarded Silver Stars.

If 48th TFW(P) crews had been forced to engage the enemy MiGs they would have probably been able to use AIM-9Ps effectively, given favourable circumstances. Col Larry Peters tested the weapon at Eglin AFB in 1974;

'We fired at the BQM drone. We had three kills from three shots. Two were "splashes" (the drone was actually shot down) and the other was only a few feet off. We determined that the F-111 was a great platform for the AIM-9 Sidewinder because of its low-hanging pylons. We called it "free air", meaning that there was very little disturbance from the wing or fuselage.'

Although Iraqi fighters were occasionally encountered, F-15Cs had full responsibility for protecting the strike forces. Their mere presence was often more than enough to convince the IrAF MiG pilots to withdraw to a safe distance, rather than engage Coalition strike packages. For those that did evade the US air superiority shield, F/EF-111 crews had the defensive options of chaff, flares and flying TFR at lower altitudes – which proved more than enough to defeat IrAF fighters throughout *Desert Storm*.

The GBU-24/Bs on this 492nd TFS F-111F receive 'last chance' inspections from groundcrew before it leads another two-ship mission (*DoD*)

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F/EF-111 crews were not prepared for air-to-air engagements, however, their aircraft lacking the manoeuvrability to engage in that sort of combat. Several F-111E/F pilots who converted to the F-15E post-*Desert Storm* found real difficulty in adapting to the air-to-air component of the Strike Eagle training syllabus as there was little emphasis placed on it whilst assigned to the F-111.

After the devastation of Iraq's fighter capability on the opening night of *Desert Storm*, the mission planners ordered the AIM-9Ps that were carried by the F-111Fs as a precaution to be downloaded. With the removal of most fighter, command and control and missile threats completed in the first few nights, it was possible to fly most F-111F missions at altitudes between 12,000 ft and 20,000 ft, launching LGBs from triangular 'race-track' orbits with the aircraft flying in trail and lasing their ordnance against targets such as aircraft shelters.

When Iraqi Scud missiles began to land in Israel (with the possibility of chemical or biological warheads to follow) on 18 January contingency plans were laid to use F-111Fs and F-117As to strike three dams on the Tigris and Euphrates rivers, flooding Baghdad. This proposal followed earlier schemes to destroy Iraq's 18 biological warfare storage bunker sites. F-117A 'Black jets' would open up the bunkers with GBU-27s, followed immediately by CBU-89 Gators from F-111Fs to destroy the escaping germ spores before they could disperse into the atmosphere.

The F-111Fs' Salman Pak target on the first night of the war was indeed a chemical and biological warfare storage complex containing anthrax spores. This required the 48th TFW(P) crews to fly in full chemical warfare protective kit, with 'gas masks' at the ready and the aircraft's air conditioning turned off. 'Ram' flight of F-111Fs tossed CBU-89 Gators from low-altitude, having approached the target at a speed of 570 knots from over the base's shelter area in an attempt to isolate Iraqi personnel from the spores after F-117As had blown open the storage bunkers with LGBs. SAM and AAA opposition was extremely heavy, including lethal SA-6 'Gainful' and SA-8 'Gecko' missiles, most of which were handled by F-4G *Wild Weasel* crews and the F-111Fs' own countermeasures while an intruding Iraqi Mirage F 1EQ was destroyed by the F-15C CAP.

Upon returning to Taif after flying for more than five hours, the four F-111F crews had to remain in their cockpits while the aircraft, the cockpit interiors and their own suits were washed or scrubbed down by life support troops in similar chemical warfare kit to their own in case any anthrax contamination had occurred. Ironically, the F-117As had not reached the target due to poor weather, so no spores had escaped.

Other shelters that were suspected of hiding Scuds and similar missiles were also attacked by F-111Fs. The search radar in the F-111E/F and F-16C could not resolve and identify a relatively small object like a Scud-B missile and its MAZ-543 launcher outside a shelter at night, so the task fell mainly to the F-15E with its advanced synthetic aperture radar. 'Scud hunting', although ultimately fruitless, remained the top priority until 21 January, when Col Warden calculated that the minimal showing by Saddam's huge air force in the first week signified imminent Iraqi plans for a mass attack on Tel Aviv and Riyadh by up to 300 aircraft. Warden revised his tactics toward the IrAF, fearing an 'aerial Tet Offensive' if it was not neutralised.

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It was also thought that the spectre of chemical and biological weapons might emerge in aerial attacks on Coalition forces entering Kuwait. Although the bulk of Warden's original target list had been dealt with on the first two nights, airfields and aircraft storage once again became the focus of planning. This led to concerted attacks by all the Coalition strike aircraft, including large waves of 20 to 24 F-111s, on shelters at Al Asad and the vast H-2 air base.

48th TFW(P) pilots had already 'cracked' shelters at Ali-Al-Salem on the first night of *Desert Storm*, aiming their PAVE Tack-guided weapons at the hangar doors – bombs were delivered from multi-axis attacks at various altitudes. US Navy A-6E and A-7E squadrons were initially part of the renewed airfield attack plan, but when they targeted Ali-Al-Salem on 23 January it was found that their AGM-62 Walleye glide-bombs only scarred the tough concrete HASs. The naval aircraft were quickly deployed elsewhere.

F-111 crews initially experienced similar problems with the Kuwaiti 'Super HASs' due to their heavily reinforced structures. However, they soon developed a tactic called 'consecutive miracles' to overcome this obstacle. It involved dropping a GBU-24 penetrator vertically onto the centre of the shelter arch to blow a hole through the roof. A second bomb, dropped a few hundredths of a second later, passed through the hole to vaporise the contents of the shelter – frequently an IrAF aircraft. A large secondary explosion often indicated the presence of at least one fuelled and armed fighter detonating inside the structure. The Iraqis quickly learned to hide inside the HASs during the day, when 'dumb bombers' were scattering ordnance about ineffectively, and stay outside of them at night when the F-111Fs showed up to wreck the shelters.

Only one of the 23 January airfield strikes had to be abandoned when very low cloud made PAVE Tack use impossible, forcing 20 F-111Fs to return home with their ordnance still aboard.

Early in the war F-111Fs often carried only two GBU-10s, although mixed loads of GBU-10s and GBU-24s were common. Mk 84s fitted with BSU-50 AIR fins were added in poor weather if area bombing without using PAVE Tack was needed.

In late January airfield attacks were revised, with larger formations being used to make coordinated attacks from different directions seconds apart, or figure-of-eight ground tracks, dropping a pair of bombs on a HAS in each of two passes. Shortly after this concerted destruction commenced the IrAF began to fly its surviving aircraft to sanctuary in Iran, although several machines were brought down en route by Coalition

Senior Airman Andrew Palmer uses a bomb loader to raise a 2000-lb bomb toward the weapons rack of a 494th TFS/48th TFW(P) F-111F at Taif prior to the jet flying a night mission during *Desert Storm* (*DVIC*)

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fighters or destroyed by F-111Fs at Tuz Khurmatu airfields near Kirkuk, where the Iraqis had paused for fuel, hiding their aircraft in hardened shelters or civilian areas.

Despite most of these lasered drops being made from high altitude, targets were still easy to designate during the weapon's one-minute fall to earth. Wind interference was more prominent, but LGBs (particularly Paveway IIIs) could usually handle this, as well as dust, smoke and debris, around the aim points. Although the 'consecutive miracles' method went against the manufacturer's (Texas Instruments) slogan – 'One target, one bomb' – for its Paveway III, it caused immense destruction to the multi-million dollar 'bomb-proof' shelter complexes, and to Iraqi morale, while also producing spectacular PAVE Tack imagery for the world's media. In one case a WSO was able to redirect his weapons twice during their fall to earth as he saw bombs from other F-111Fs hit his first two shelter targets and he finally lased and hit a third HAS.

Generally, an average of four LGBs were used for each target by Coalition aircraft capable of carrying them, and sometimes this increased to eight or more – particularly when inadequate BDA (bomb damage assessment) left planners uncertain about the degree of damage, and re-strikes were ordered. Very few targets took only one weapon, even when the BLU-109/B penetrating warhead was used. Talil airfield was one target area where many shelters were hit by two or more LGBs, and one structure by as many as seven. Of the 375 shelters that were struck during the conflict, 245 (and 141 aircraft concealed in and around them) were destroyed by F-111Fs.

In addition to the state-of-the-art Paveway III weapons that became available from April 1986 and made their combat debut in *Desert Storm* on F-111Fs and F-15Es, many Texas Instruments Paveway I and II bombs were also used during the war. Paveway I had fixed rear fins while Paveway II used 'pop-out' rectangular fins for increased stand-off range. Their guidance worked on the 'slam' principle. The fins would fully deflect, or 'slam' over in one direction, to guide the bomb during its 60-second fall from medium altitude, then slam completely in the opposite direction for a correction to the flightpath, and so on. This clattering sound could be heard by those who were beneath its trajectory, and the 'slamming' quickly used up the bomb's energy. WSOs therefore allowed the bomb to fall more than halfway to its target before beginning to lase it home.

Paveway III, which replaced the gimballed seeker of earlier versions with a fixed seeker unit, could be dropped from lower altitudes in a toss manoeuvre as it had a more subtle, auto-pilot aided guidance system. GBU-10J/B used GBU-10 tail and guidance sections mated to a BLU-109 penetrator.

Despite the emphasis on LGBs in the public presentation of the war, only eight per cent of the total ordnance expended was guided. The remaining 92 per cent consisted of 'dumb' bombs dropped mostly by other Coalition aircraft. Poor weather and impeded visibility were partly to blame for this imbalance, as was the high cost of precision munitions (the eight per cent of ordnance that was guided cost 84 per cent of the total ordnance bill), smaller stocks of LGBs and the large area of many of the strategic targets attacked in Iraq.

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'DUCK MISSION'

Reconnaissance on 25 January revealed that Saddam's troops were extending a campaign of sabotaging Kuwait's oil well-heads to the Al Ahmadi oil terminal, where a million barrels of oil were released from tankers. A pipeline to the Sea Island loading terminal was also left open, spilling more than 11 million barrels. The end result of this campaign was a major environmental disaster four times worse than any previous oil-spill. After studying Kuwaiti blueprints of the terminal, a plan was devised to ignite and burn off the oil-stream and 'surgically' attack the manifold structures ashore, cutting off the leak.

Five GBU-15-capable F-111Fs at Taif were prepared for this task (nicknamed the 'duck mission', as one of its aims was to preserve cormorant colonies) on 26 January, but Gen Schwarzkopf's doubts about the possible extent of the damage they might trigger off, combined with poor weather, delayed takeoff until the following day. By that time oil had been released into the sea at 1.2 million barrels per day for at least three days.

The first batches of F-111Fs to deploy to Taif included eight that were adapted to launch the GBU-15 data-linked glide-bomb. Seventy-one GBU-15s were dropped, all from F-111Fs, in attacks from the first night of *Desert Storm* onwards, but the most notable were the GBU-15(V)-2/Bs

A GBU-15 uploaded onto 493rd TFS F-111F 70-2412. The nose contained either a TV or infra-red (night or bad weather) guidance section. In the tail section of the weapon a data-link unit worked with the AN/AXQ-14 pod on the aircraft allowing the WSO to guide the bomb for an indirect attack. Alternatively, the weapon could be locked onto a pre-selected target before launch for a direct attack, which meant that it would guide itself automatically to the aim point, allowing the F-111 to exit the vicinity and avoid being engaged by the target's defences (*Author*)

F-111F 70-2415 of the 493rd TFS was photographed during a training mission in 1985, the jet being loaded with a GBU-15(V)1(T-1)B training round and an AN/AXQ-14 data-link pod to guide the weapon (*Jim Rotramel*)

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Desert Storm **veteran F-111F 72-1450 of the 493rd TFS was photographed with a pair of GBU-15s underwing, an AN/AXQ-14 data-link pod beneath the rear fuselage and an AN/ALQ-131 ECM pod moved to a forward mounting on the bulged PAVE Tack cradle. In all, 71 GBU-15s (costing $227,600 each) were launched during *Desert Storm*. At a mere $1871 per copy, and capable of achieving the same results with a direct hit, the humble Mk 84 GP bomb appeared cheap by comparison (*Jim Rotramel*)**

(a Mk 84 warhead with IIR guidance and the original long-chord wings) delivered during the Al Ahmadi mission.

The Rockwell-built weapon was developed at the Air Force Development Test Center at Eglin AFB from 1974, and the TV-guided GBU-15(V)1/B test programme was completed in November 1983. The weapon duly entered service with the 493rd TFS at Lakenheath just weeks later. Trials of the imaging infra-red GBU-15(V)-2/B were finished by February 1985. Development then passed to Air Force Logistics Command, and from 1999 the GBU-15 also received a GPS add-on. The 12 ft 10 in GBU-15 weighed 3640 lbs (3655 lbs for the IIR version) and used a Mk 84 warhead with 945 lbs of Tritonal explosive, or a BLU-109 penetrating warhead with 535 lbs of Tritonal (as the GBU-15(V)31 TV and GBU-15(V)32/B IIR guided versions, both using the later, narrow-chord wings). Its 4 ft 11 in span wings gave it a range of up to 15 miles – further than LGBs.

Either a TV sensor or an IIR guidance section similar to the Hughes-built one used on the AGM-65D Maverick could be attached, depending on whether the mission was during day or night and in good or poor visibility conditions. In direct mode, the pilot located the target using the weapon's camera imagery on his cockpit display – TV for a daylight mission or an infra-red imaging view at night or in poor visibility. He locked the weapon on target using cross-hairs on the display and released the bomb, which then guided to the target. In automatic mode the bomb was dropped from a loft manoeuvre, the weapon then following a programmed trajectory to the target. Course corrections were provided automatically in flight via the Hughes AN/AXQ-14 data link

Capt Bradley Seipel (WSO) and Capt Michael Russell (pilot) strap themselves into the cockpit of a 48th TFW(P) F-111F in preparation for a mission during *Desert Storm* (*DVIC*)

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F-111F 73-0712, assigned to the CO of the 494th TFS, taxis out at Taif armed with LGBs and fitted with an ALQ-131 shallow configuration ECM pod between the fuselage strakes. Wings were usually set at 54 degrees sweep for taxiing with spoilers extended, slats lowered and flaps at 25 degrees. Takeoff was at around 185 mph (*DVIC*)

pod (hung beneath the F-111F's rear fuselage) to the bomb's autopilot, which steered it by using the tail-wings.

On Night One of *Desert Storm* several F-111Fs sortied with two GBU-15s each, dropping one bomb ahead of a follow-up strike on the same HAS target by another aircraft with a GBU-24. The main infra-red version supplied to the 48th TFW(P) was particularly effective against 'soft' targets, or to damage a hardened target sufficiently for a GBU-10 or GBU-24 to finish it off. The GBU-15s dropped during the Gulf War scored a 98 per cent success rate.

At Lakenheath a select group of 493rd TFS 'Freedom Squadron' crews had gained experience with the weapon, which they normally delivered as a pair. One F-111F would launch the GBU-15 at high speed to give it maximum glide range while the WSO in the second 'buddy' aircraft used the AN/AXQ-14 data-link pod imagery on his video display and a small toggle 'joystick' to guide it home. This group of 493rd TFS personnel provided the crews for the Al Ahmadi strike on 27 January.

Four aircraft operated as buddy pairs, each with one jet as the GBU-15 launcher and the second flying more than 50 miles off-shore to guide the weapon through data link. Capts Rick 'Spanky' Walker and Ken Theurer, in F-111F 72-1446 ('Charger 34'), made the first supersonic drop eight miles from the target at 15,000 ft and then turned away to avoid heavy AAA, while the guiding F-111F, 65 miles away, linked to the infra-red sensing bomb. Contact with the weapon was lost soon afterwards so a second GBU-15 was launched, also at supersonic speed, by Maj Sammy Samson and Capt Steve Williams from F-111F 70-1452 ('Charger 35'). Its signal was picked up by WSO Capt Brad Seipel and pilot Capt Mike Russell from 50 miles distance in 'Charger 32' (70-2414).

Seipel, who had flown in the lead F-111F attacking Saddam's Tikrit palace on Night One of the war, guided the bomb to a direct hit on one of the manifold structures and then picked up and directed a second bomb from Samson's aircraft for a hit on the other manifold building three miles away. It took a day for the oil in the pipelines to burn out, but the spillage was almost stopped. A second data-link aircraft (70-2408 'Charger 31') was flown by Capt Ben Snyder and Maj Jim Gentleman and a fifth jet, 70-2404 'Charger 33', crewed by Capts John Taylor and Seth Bretscher, had to abort the mission with technical problems.

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Craig 'Quizmo' Brown, who completed 26 *Desert Storm* missions with the 494th TFS, later learned that most of the Canadian Armed Forces' CF-18 detachment (from Nos 439 and 416 Sqns) was airborne to provide cover for this risky, but vital, operation.

As part of their tasking against 'hard' targets, the 48th TFW(P) struck many of Iraq's river bridges from 29 January, knocking out 52 in total (around half the number that were destroyed by all Coalition aircraft), together with the fibre-optic communications lines that were often built into them. The five-mile-long bridge and causeway route over the Hawr Al Hammar Lake near Basrah was the first transport infrastructure target attacked by the wing. In all, 160 direct hits were scored by GBU-15s against the road and rail spans and GBU-24s with standard Mk 84 warheads on the weak points at each end of the bridge. The hardened BLU-109 warheads that were used on the first attacks tended to pass through the bridge structure before exploding.

Also on the target list was the Tuwaitha nuclear research facility close to Baghdad, which, in 1981, had been severely damaged by the Israeli Defence Force Air Force and its three French-built Tamuz reactors destroyed. Further damage was caused by F-117A and F-16C bombing, but the large Russian-built reactor was still operating on 4 February, and was allegedly the most heavily-defended target in the Middle East when 18 F-111Fs, led by Lt Col James Slaton and WSO Capt John F Daughtry, destroyed it with deadly accurate PAVE Tack strikes. Their F-111F (72-1445 'Remit 32' in the Libya attacks) was one of only two that made it to the target, flying under a cloud deck with a weapons system that failed and had to be sorted out just before the attack. Both crewmembers were awarded Silver Stars.

'PLINKERS'

After ten days of battle much of Saddam's vast war machine remained intact, including half of the strategic targets, virtually all the mobile Scud launchers and all but 25 of his 800 battle tanks. F-111s and F-117As were

F-111F 70-2391 from the 495th TFS at Taif in 1991. Its underwing load of four GBU-12D/Bs was typical for a 'tank plinking' sortie (*John 'Bear' Daughtry*)

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the only strike aircraft to maintain high sortie rates against major targets, as other tactical aircraft were impeded by bad weather or the ceaseless hunt for Scuds. While US Army and US Marine Corps commanders concentrated on driving Iraqi forces from Kuwait, Brig Gen 'Buster' C Glosson, in charge of USAF air assets, focused on weakening Saddam's homeland industrial and military base through air power alone.

Tanks, particularly those that were embedded in sand and disguised by netting in Kuwait, had escaped destruction from tactical aircraft due to their effective camouflage and the anti-aircraft hazards when flying low enough to destroy them with direct hits from 'dumb bombs' dropped by F-16s, AV-8B Harriers or A-10A Thunderbolt IIs. CBUs were suggested, but the effects of their sub-munitions were easily absorbed by the sand dugouts and revetments in which the tanks were hidden.

Mid-way through the campaign, Gen Schwartzkopf was persistently accused by the media of a lack of progress in destroying enough tanks to allow the ground war to start. The 48th TFW(P) was asked by Gen Glosson to devise a solution using PAVE Tack. Previous experience in trials dubbed 'Night Camel' during *Desert Shield* had shown that widely-spaced American tanks were hard to identify using the F-111F's sensors if they had been standing with their engines switched off for some time. However, crews from the wing discovered that PAVE Tack's infra-red detection set could recognise the solar warmth retained by sun-heated tank hulls compared with the cold desert around them. It was also found that Iraqi tank troops kept their engines running at night in order to keep warm, thus raising the heat signature of the tanks.

On 5 February Col Lennon and his regular WSO Steve Williams led two F-111Fs over the northern Kuwaiti border at 2100 hrs. Whilst flying at an altitude of 14,000 ft, PAVE Tack revealed the heat signatures of several Republican Guard tanks on Williams' VID. The two aircraft targeted and dropped GBU-12D/B Paveway IIs on eight of the luminous traces, and seven disappeared, accompanied by numerous secondary explosions. Seven Republican Guard battle tanks or personnel carriers had been knocked out. Two nights later a mass launch of 40 F-111Fs against designated 'tank box' target areas on the northern Kuwaiti border initiated a programme of rapid attrition of the main obstacle to re-taking the country. Shortly thereafter Gen Schwartzkopf coyly announced to the press that they had come up with an answer to the tank-killing problem without directly stating that, once again, the 48th TFW was answering the call when others could not.

Tank destruction soon occupied 44 per cent of the wing's time as it delivered 2500 GBU-12s on Iraqi armour out of its total of 4666 LGBs expended – more than half of the precision-guided munitions (PGMs) dropped by Coalition aircraft. A formation of 20 F-111Fs knocked out 77 tanks with 80 GBU-12s in one night, and in general results were up to ten times better than the daylight bombing scores by F-16s against similar targets. In fact, the inaccurate dumb-bombing during daytime by Fighting Falcon pilots became such a problem (by creating hot-spots in the desert that could be mistaken for tanks at night) that they were ordered to stay away from the tank 'kill box' target areas during afternoon hours.

The 48th TFW(P) switched fully to anti-tank 'plinking' from 13 February, when 46 F-111Fs hit 132 tanks and other armoured vehicles

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– each jet dropped four bombs. By the end of the war one crew was credited with 31 tank kills among a score of 920, and 252 artillery pieces, for the 'Liberty Wing'. Tank 'plinking' was later performed by F-15Es using similar infra-red targeting, which could often distinguish 'live' targets from those that had already been destroyed. Gen Schwartzkopf, who described himself as a former tank driver, found the expression tank 'plinking' (devised by F-111F flyer Maj Cliff Smith) demeaning and duly banned it. His troops subsequently came up with suitable synonyms such as 'busting' or 'popping'.

The anti-tank tasking was made easier for crews operating over Kuwaiti terrain due to the flat, open landscape and lack of cover from foliage. Tanks were often dug into the sand in set patterns for long periods, aiding location and avoiding 'blue on blue' mishaps. However, uncharacteristically poor weather (including 50 per cent cloud cover on half of the 43 days of the campaign) made that task of target acquisition harder for electro-optical systems like the F-111F's. Radar-guidance could still be used for 'dumb' bombs, but again with reduced accuracy.

Ironically, the tank 'plinking', although vital to the war effort, actually hurt F-111 bombing statistics after the war. When LGBs were cleared for the jet during the Cold War, it was only for 'parent carriage' (i.e. one bomb per pylon) – this restriction also applied to the 500-lb GBU-12. The concept of hitting multiple tanks with PGMs dropped from F-111s in a relatively permissive environment was not contemplated. When huge numbers of sorties were dedicated to tank 'plinking', the ordnance tonnage statistics showed the F-111s delivering only one ton of bombs per sortie (four GBU-12s against four tanks), while the F-117As were delivering twice that weight with two one-ton GBU-27s – the RAAF later cleared its F-111Cs to carry ten GBU-12s using four BRU-3A/As weapons pylons. To the shallow thinkers in the Pentagon, this was yet another way to denigrate the F-111.

Correctly assessing the results of bombing was a problem throughout the war as many aircraft – including the F-15E – only had videotape recorders in their head-up displays. These were restricted to showing the target in daylight *before* weapons had impacted. F-111s and F-117As, however, had the ability to produce infra-red recordings of their sensor imagery that showed the whole bombing process by night. This footage was the most helpful source for evaluating tank 'plinking' since aerial and satellite reconnaissance imagery was often obscured by cloud. PAVE Tack's turret would swing to the rear or side of the aircraft to lase bombs onto the target, and that imagery was available for immediate analysis – and media consumption.

However, military personnel analysing the infra-red recordings had difficulty in distinguishing whether small targets like tanks or trucks had already been hit, and the lack of on-the-spot information from ground or reconnaissance sources led to some wasted LGBs on 'dead' targets. Lacking adequate satellite imagery, intelligence agencies, particularly the Central Intelligence Agency (CIA), were sceptical about the Coalition's claimed attrition of armour. These statistics mattered because Schwartzkopf's decision on the timing of a land operation into Kuwait depended on reducing Iraqi armour and artillery by about 50 per cent. By 16 February estimates varied widely, but the CIA would still only confirm 30 per cent attrition.

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Occasionally, the effects of the bombing on other targets produced secondary explosions that left little doubt about the results, particularly when the Iraqis' colossal munitions storage areas were hit. On 28 January, for example, Capts Matt Young and Greg Chapman put an LGB into a weapons storage area at Talil air base that produced the biggest non-nuclear, man-made explosion ever registered by US Defence Support Program satellites.

While the 'progressive and systematic collapse of Saddam Hussein's entire war machine and regime' (as Department of Defense statements predicted) continued, the issue of whether the leader himself would be a casualty, either by accident or design, was frequently raised. A survivor of numerous assassination attempts, the elusive Saddam kept on the move and stayed away from his known retreats while they became targets for 400 strike sorties. American mobile home vehicles in which he was (incorrectly) reputed to travel were sought. Two were hit, the first with a GBU-12 from an F-15E and the second on a later mission by a flight of F-111s that completely destroyed the vehicle.

The emphasis then returned to unseating Saddam and routing his forces by destroying the upper levels of his command structure. The latter was thought to operate from some of the ten Finnish-built air raid shelters in Baghdad, each one sufficiently hardened to resist a nuclear explosion. No activity was detected near them until early February, but one, known as the Al Firdos bunker, was assumed to be a command and control centre. It was hit by two F-117As on 13 February, but tragically the underground structure was actually full of civilians sheltering from air raids, and more than 200 died.

RAVENOUS RADIATION

Electronic warfare was vital in the very rapid reduction of Iraq's integrated air defence system (IADS), which used Soviet P-35M and P-37 'Bar Lock' radars for long-range surveillance. These systems, linked by microwave and land-line to control centres, were supported by numerous 'Spoon

Twelve EF-111A Ravens from the 390th ECS/366th TFW at Mountain Home AFB deployed to Taif, where they were considered an essential component for the majority of missions. An F-111F taxis on the superheated Taif perimeter track in the background (*DVIC*)

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Rest', P-15 'Flat Face' and P-15M 'Squat Eye' acquisition radars that controlled SAM and AAA sites. Many of the SAM sites housed Vietnam-era SA-2 'Guidelines', and their associated 'Fan Song' radar units, but these were still effective alongside a wide range of more modern missiles such as the SA-3 'Goa', SA-6 'Gainful' and point-defence SAMs like the SA-8 'Gecko', SA-9 'Gaskin' and Euromissile Roland. The latter trio were a particular threat to low-fliers like the F-111.

EF-111As, together with EC-130 *Compass Call* communications jamming aircraft and the 39 EA-6Bs of the US Navy and US Marine Corps, blinded and deafened the IADS' radars and communications network on the first night, rendering any sort of concerted defences virtually impossible. Local radar units that then chose to independently engage imminent attackers could be attacked by F-4G *Wild Weasel* or A-7E and F/A-18 SEAD aircraft.

The 18 EF-111As of the 390th ECS at Taif, with six more from the 42nd ECS at Incirlik, were in constant demand to escort strike packages and disrupt the IrAF's ground control systems by neutralising radars with noise jamming and false target information. Although the EF-111As lacked an upgrade to their AN/ALQ-99E semi-automated jamming suite that had recently been applied to the EA-6Bs' version of the system, they were able to deal with most threats in-theatre, as the Iraqis possessed mainly older, lower band Soviet radars. They could set up stand-off jamming orbits at a distance from the threat area, or fly with the strike package as direct escorts. For the first phases of the battle their role was so vital that strike packages could not enter enemy airspace without their support. Even the stealthy F-117A 'Wobblin' Goblin' benefited from their help as the Nighthawk was not undetectable by radar, although its radar signature was much smaller than that of non-stealth aircraft.

The Ravens' workload was increased by the fact that of the USAF's various strike aircraft types, only the F-111 and F-15E had effective internal jamming equipment. The F-16, F-4 and A-10 were particularly vulnerable to enemy radars and missiles, these aircraft relying on their own AN/ALQ-131 jamming pods for EW support. In all, 38 Coalition fixed-wing aircraft were lost, but only three to radar-guided missiles and none in situations where the 'protecting wings' of the Raven were present.

The only EF-111A combat loss occurred on 14 February when *Combat Lancer* veteran 66-0023 'Wrench 08' crashed shortly after it had crossed the Saudi Arabia border. Possibly locked up in error by a Coalition fighter, Capts Douglas Bradt and Paul Eichenlaub assumed that they were being tailed by a MiG and took the normal precaution of diving to the lowest feasible altitude. Tragically, their aircraft struck the desert, leaving a long streak in the sand with the engines at its conclusion. The crew died in an unsuccessful ejection attempt.

LAST GO

After the 'land war' began on 24 February attempts to destroy Saddam's underground command and control network continued, culminating in the rapid development of a new weapon as part of Operation *Deep Throat* that it was hoped would reach the deepest levels of his concrete warrens. The Raytheon/Texas Instruments GBU-28 'Bunker Buster' was initially only cleared to be carried by the F-111F. The USAF would have preferred

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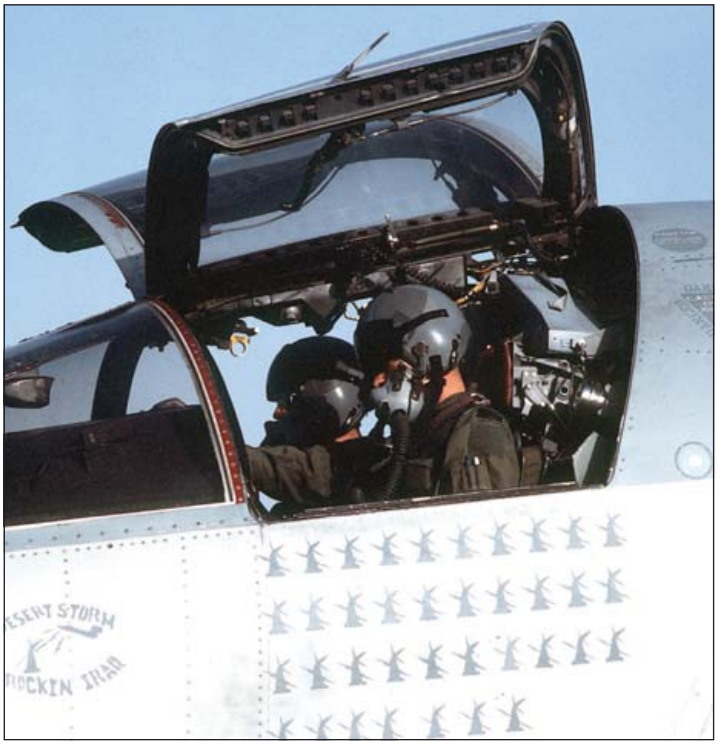
EF-111A 66-0037, which was the first Raven to be delivered to the 42nd ECS at Upper Heyford (nicknamed *NATO Raven One* and, later, *Prowler*), has 39 ECM mission hash-marks in yellow beneath its canopy, signifying its period of service alongside 390th ECS jets at Taif (*Author*)

that the weapon was compatible with the F-15E, but there were technical limitations that prevented this from happening until after the war.

The bomb had been improvised in a record two-month programme to meet a specific need – the destruction of bunkers that lay too deep for the standard BLU-109 penetrating warhead fitted to the GBU-24. It was thought that around 40 bunkers in Baghdad were buried up to 50 ft below the surface, with two feet-thick concrete slabs covering networks of inter-connected concrete tubes and chambers, each of which housed command and control facilities for more than 1000 military personnel. The bunkers also contained sufficient supplies for their occupants to remain underground for several weeks at a time.



The 18 EF-111A Ravens based at Taif and another five at Incirlik flew more than 900 sorties during *Desert Storm*, and many returned with impressive scoreboards like this one. The open canopies reveal the centre beam above the crews' heads, which housed the yellow ring for the emergency parachute handle and controls for manual operation of the flotation gear and parachute severance – the latter was activated if any of the escape module's automatic systems failed (*DVIC*)

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The 48th TFW(P) force at Taif included F-111F 71-0891 of the 493rd TFS/AMU, which was later converted to *Pacer Strike* standard and transferred to the 524th TFS (*DoD*)

This impressive scoreboard, reminiscent of those applied to heavy bombers in World War 2, was worn by the 495th TFS CO's F-111F (70-2391). On the penultimate day of the war '391' dropped the first GBU-28/B 'Deep Throat' 4700-lb bunker-busting bomb on Al Taji air base (*USAF*)

Potential manufacturers of the weapon were given a ten-week deadline to find a solution before 15 January 1991 – the date on which it was assumed that hostilities would begin. A ready-made solution to the creation of a suitable body for the weapon came when a Lockheed employee suggested using surplus, worn-out M201 howitzer barrels stored by the US Army. Two examples were shortened, re-bored to ten inches internal diameter, fitted with 4400-lb BLU-113 noses and loaded with 630 lbs of Tritonal explosive. Texas Instruments mated the GBU-24's WGU-36 guidance section and BSG-92 Airfoil Group (with clipped GBU-24-like canards and a tail and nose adaptor similar to the GBU-10's MXU-651) to the 13-ft long body and devised control parameters using computer simulation.

In the first test at Tonopah Range on 24 February 1991, 431st TES F-111F 74-0186 (also used to trial the PAVE Tack system) performed the only GBU-28/B test over the desert terrain, and it penetrated to an inaccessible depth of more than 100 ft. Four days later the bomb was used operationally in Iraq. A later test using a rocket-powered sled on rails launched a GBU-28A/B against an array of steel-reinforced slabs some 22 ft thick. The bomb passed through the whole stack and continued down-range for another 2500 yards!

Two GBU-28/Bs were flown to Taif by C-141 transport on 27 February, the weapons being accompanied by a WSO from the 431st TES. It was his job to brief the 48th TFW(P) crews that had been selected for the first mission with the new weapon. Only five hours after the bombs arrived, two F-111Fs (70-2391 – the 495th TFS commander's aircraft – and 70-2387 from

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the 493rd TFS) were loaded. Armourers also uploaded a single Mk 84 to counterbalance the GBU-28/Bs' 5000-lb weight. Both jets were tasked with targeting command bunkers beneath Al Taji air base, northwest of Baghdad, these having so far resisted F-117A bombing with GBU-27s. The two F-111Fs, 'Cardinal 7-1' and '7-2', could laser-mark the target for each other or target-mark and guide their own weapons.

Lt Col Ken Combs and Maj Jerry Hust in the first F-111F narrowly missed the target, so they quickly diverted 'Cardinal 7-2' (70-2387), flown by Col David White and Capt Tommy Himes, from its intended secondary target to the primary. Analysis of the PAVE Tack VCR film showed the second weapon impacting at its aim-point, and moments later smoke was seen surging from the bunker's air-vents. This indicated a devastating explosion within the bunker. An Iraqi ceasefire the following day may have been prompted by this unexpected denial of their supposedly safe retreat, although Saddam was not in the Al Taji bunker. Other similar bunkers under Baghdad – the last resort of Saddam's high command – would also have been targeted if the conflict had continued.

The 32 combat mission 'bombs' on this 55th TFS F-111E (68-0036) were initially applied in blue (the squadron colour), as seen here. However, these markings were usually reapplied in tan when retained post-war. This aircraft had been nicknamed *Wild Fire* in the mid-1980s (*Mike Gibson*)

The F-111E/Fs had flown their final mission of *Desert Storm*. GBU-28s duly joined the USAF's arsenal, and a developed version (designated the GBU-37), fitted with GPS, was made available for the B-2A Spirit.

Incirlik's F-111Es began to return to Upper Heyford on 9 March 1991, with 68-0049, flown by Col Ken Peck, leading the first four-ship into the base. The detachment of EF-111As from the 42nd ECS remained at Incirlik until June 1992, however. The Ravens' role was to support a detachment of 11 F-111Fs from the 494th TFS (later replaced by the 492nd TFS) that contributed to the United Nations' Operation *Provide Comfort* (an attempt to protect the Kurds in northern Iraq from Saddam Hussein's continued persecution) from 5 April 1991. In October 1992 this duty passed to the 27th FW, which took over Lakenheath's F-111Fs.

The 42nd ECS maintained its detachments in Turkey and Saudi Arabia from 25 September 1991 through to 26 June 1992, periodically rotating aircraft back to Upper Heyford. The 390th ECS/366th TFW then assumed the responsibility, absorbing 42nd ECS Ravens from June 1992 onwards ahead of the Upper Heyford unit's deactivation on 10 July. The 42nd's deployments to Dhahran continued through to February 1992, some of the aircraft displaying a blue 'Deja Vu' slogan on their left splitter plates to underline the frequency of their visits to the area. After June 1992 the 366th TFW Raven Detachment moved to Dhahran, although it also continued to provide EF-111A support for *Provide Comfort* in northern Iraq until 1996.

Derived from the 'Yankee Air Pirate' nose art often used in Vietnam, this EF-111A (66-0013) from the 429th ECS was suitably decorated by Senior Airman Vanessa Snedeker for its *Provide Comfort/Southern Watch* duties at Incirlik in 1994. Having begun life in November 1967 as the first operational production F-111A, the aircraft later received *Harvest Reaper* updates. It was then used to train many of the crews for the *Combat Lancer* deployment. More than a decade later 66-0013 became the ninth F-111A to be converted into a Raven (*via Mike Kaplan*)

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Operation *Northern Watch* followed on from Operation *Provide Comfort,* enforcing a no-fly zone above the 36th parallel in Iraq. EF-111As from Cannon AFB had flown more than 2800 sorties in support of *Provide Comfort, Northern Watch* and *Southern Watch* by the time the detachment ended on 24 June 1997. A short while later all surviving EF-111As were retired (*DVIC*)

Meanwhile, the rest of the 48th TFW's aircraft flew back to Lakenheath from Taif from 11 March 1991, the wing being led home by Col Lennon and Capt Steve Williams in F-111F 72-1448. While the bulk of the 48th soon resumed NATO duties, a small detachment remained on alert at Taif until 11 May. Three of the Lakenheath squadrons, boasting around 18 F-111Fs each, had flown more than 650 missions apiece during the conflict, while the 495th TFS, with only 13 jets on strength, flew 458.

One-third of the entire F-111 fleet had been committed to war, yet not a single aircraft was downed by the enemy. Maintainers from the 48th TFW(P) and 20th TFW achieved outstanding availability rates (only 66 aborts in more than 2500 missions, with more than 60 sorties being flown per day during *Desert Storm*), completely reversing the poor serviceability record gained by the F-111 in its early service years. Avionics, which played up in the high humidity of Southeast Asia or the damp chill of northern Europe, held up much better in the dry heat of the Middle East. Indeed, 48th TFW(P) aircraft achieved an 85 per cent availability rate, and no engine changes or repairs were required apart from routine inspections, while the Incirlik-based F-111Es lost only a handful of sorties due to maintenance breakages.

At Taif, F-111Fs 74-0181, 74-0178, 70-3403 and 70-2396 (three of which were *El Dorado Canyon* participants) flew the highest mission totals, with 74-0178 completing an unmatched 56 sorties. Many of the deployed EF-111As averaged at least one mission per day. For the 48th TFW(P) – the only USAF wing to send all of its squadrons to the conflict – this meant two to three sorties per week for each crew, and a maximum of one a day. Capt Brad Robert and 1Lt Troy Stone flew 37 missions, which was the highest total for any crew.

Lakenheath's 'greatest hits' were recorded with 'low-viz' black symbols. F-111F 70-2370 has 28 bombing missions and five HAS 'kills' marked up (*Author*)

The retirement of many of the aircraft types used in *Desert Storm* very soon after the war – including the F-111, EF-111A, F-4E, RF-4C, A-6E and a large number of A-10As – meant that such a mix of types for many tasks would be impossible in future conflicts. It was also clear that the USAF's increasing reliance upon hi-tech guided weapons had to be accompanied by suitable improvements in the development of sensors that could penetrate bad weather and targets obscured by smoke and haze.

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RAAF AND THE F-111 LEGACY

RAAF F-111s participated in numerous *Red Flag* and Pacific region exercises such as *Pitch Black*, but they also flew operations in a potentially hostile situation. In 1999 F-111Cs and RF-111Cs were moved to the 'bare base' at Tindal, in the Northern Territory, as part of the No 95 Contingency Strike Wing in response to tensions over the Indonesian province of East Timor during a period of civil disorder there. Tindal was opened in 1989 (replacing RAAF Darwin) as one of several forward basing areas for strike fighters. East Timor had been taken over by Indonesia in 1975 after Portugal withdrew its colonial control, and a violent opposition to repressive Indonesian rule ended with a UN-sponsored agreement to allow East Timor independence in 1999.

The RAAF flew in support of a UN-mandated, Australian-led International Force for East Timor (INTERFET), which was sent in in September 1999 to restore order. Australia's purchase of F-111s had originally been prompted by Indonesia's expansionist policies, threatening Malaysia and Singapore. National security demanded a long-range strike aircraft to cope with that threat.

The Australian government made a formal request to Indonesia's leadership that the RAAF be allowed to fly reconnaissance missions over the area. In response, the Indonesian military stated that it would shoot down any F-111s that attempted to overfly East Timor. At Tindal, up to ten F-111Cs were kept on alert with LGBs available if strikes were indeed required in support of INTERFET. The aircraft were ready to make a 1000-mile, four-jet flight with 16,000 lbs of LGBs, which could have been used to attack Indonesian communications centres in East Timor if required.

By the end of October 1999 the Indonesian Army had renounced its claim to the disputed area and withdrawn from East Timor. Reconnaissance

RF-111C A8-146 was one of just four reconnaissance versions of the aircraft operated by the RAAF. It was one of the RAAF aircraft placed on alert during the 1999 tensions over East Timor. The reconnaissance fit was based on the cancelled RF-111A conversion, tested in 1966 by the USAF (*ADF*)

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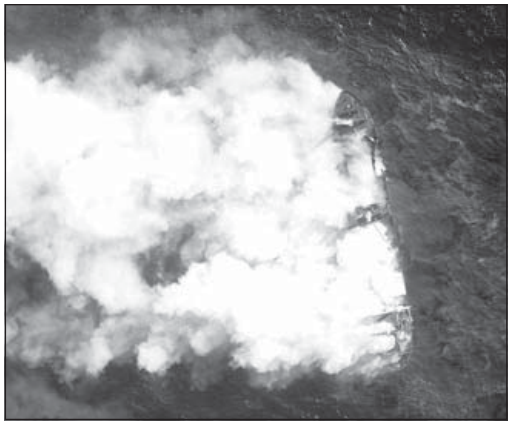

RAAF F-111s sank the 3500-tonne North Korean freighter *Pong Su* 140 kilometres off the coast of New South Wales in March 2006, the vessel being despatched with two 2000-lb LGBs. The ship had been used to deposit 150 kilograms of heroin on the coast of Victoria, *Pong Su's* crew being arrested in the act after surveillance by RAAF P-3C Orion aircraft (*ADF*)

flights by two RF-111Cs commenced on 6 November and continued until 9 December, the aircraft involved steering clear of Indonesia but providing valuable photographic data that was used to improve East Timor's road network.

In March 2006 four Amberley-based F-111s were called in to sink the *Pong Su*, a 3500-tonne North Korean freighter that had been used to smuggle 150 kilograms of heroin into Australia in 2003. Using two 2000-lb GBU-10 LGBs, they sent the drifting vessel to the bottom of the sea, demonstrating one of their primary roles as anti-shipping strikers.

Despite the F-111's excellent service record, the Australian government decided to withdraw the type in 2010, ten years ahead of its original drawdown date and despite considerable expenditure on spare aircraft and parts to sustain the fleet for an extra decade. Partly, this was due to legal action over the health issues involved in the 'deseal/reseal' chemical process required for replacing the rubber linings in the aircraft's internal fuel tanks. The F-111 also had many enemies dating back to its troubled and long-delayed introduction to RAAF service 40 years earlier.

A similar situation had affected USAF F-111s in the 1990s, despite the aircraft's outstanding combat record during Operations *Linebacker II*, *El Dorado Canyon* and *Desert Storm*. With the light of publicity firmly focused on the F-117A Nighthawk, the more versatile and successful operations performed by F-111s in *Desert Storm* were sidelined by the media. Funding for new types was in constant political debate, so inconvenient statistics such as the F-111Fs' tank-killing record, which was ten times better than that of the F-16 Fighting Falcon, were buried in case they jeopardised funding for newer types, particularly the F-22 Raptor. For the Incirlik-based 7440th Wing (P) there were additional factors concerning the political sensitivities of the Turkish government that minimised publicity of the 20th TFW's major achievements during *'Desert Storm North'*. Widespread opposition to the attacks on Tripoli also caused that operation to be played down.

For those who flew the F-111, and in many cases stayed with it for most of their military careers, the jet's qualities were never in doubt. Its long-term influence on other designs including the F-14 Tomcat, Panavia Tornado and Sukhoi Su-24 'Fencer' was profound, but its main importance lies in its fundamental contribution to three major combat scenarios, and as a vital component in winning the Cold War.

Friday, 3 December 2010 saw the finale of the F-111's operational career. Seven 'Pigs' participated in a spectacular flying display, including 'dump and burn' passes under a heavy cloud cover at RAAF Amberley. Several F-111Cs had special 1973-2010 tail markings, including A8-135 seen here in the foreground (*ADF*)

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COLOUR PLATES

1

F-111A 66-0016 of Det 1, 428th TFS/474th TFW, Takhli RTAFB, Thailand, March 1968

Delivered to the USAF on 27 November 1967, 66-0016 received *Harvest Reaper* updates for the 4480th TFS. Deployed to Thailand with the *Combat Lancer* Detachment, it flew the first F-111 combat mission on 18 March 1968, hitting a truck park and storage area with 12 M117 bombs, rather than the Mk 82s seen here. Following post-Vietnam service with the 442nd TFTS, 66-0016 was the tenth F-111A to be converted into EF-111A Raven configuration, returning to combat with the 42nd ECS in *Desert Storm* and contributing to the destruction of an IrAF Mirage F 1 that intercepted it. Reassigned to the 429th ECS/27th FW, the aircraft flew some of the final operational sorties made by the EF-111A in Operation *Southern Watch* over Iraq in 1995, and after retirement it was put on display at Cannon AFB.

2

F-111A 66-0024 of Det 1, 428th TFS/474th TFW, Takhli RTAFB, Thailand, April 1968

Received by the USAF in late January 1968, this F-111A was one of two replacement *Combat Lancer* aircraft that arrived at Takhli on 5 April 1968. Just 16 days later it became the third, and final, loss of the deployment, resulting in the deaths of Lt Cdr David Cooley and Lt Col Ed Palmgren.

3

F-111A 66-0021 of Det 1, 428th TFS/474th TFW, Takhli RTAFB, Thailand, March 1968

This *Combat Lancer* participant began its USAF career on 16 January 1968. Post-war, it was eventually transferred to the 366th TFW's 389th TFTS for training other F-111 crews prior to its conversion into an EF-111A in June 1982. Final service was with the 429th ECS/27th FW at Cannon AFB before its retirement to the Aircraft Maintenance And Regeneration Center (AMARC) at Davis-Monthan AFB, Arizona, in April 1998.

4

F-111A 67-0076 of the 429th TFS/474th TFW, Takhli RTAFB, Thailand, November 1972

A participant in the second phase of deployment for *Constant Guard V* on 27 September 1972, this aircraft carried the nickname *Superfly* on its nose-gear door. After Vietnam, the fighter's serial number prompted its choice as the 429th TFS's specially-painted 'Bicentennial Bird'. Final service with the 366th TFW preceded retirement in July 1991.

5

F-111A 67-0068 of the 429th TFS/474th TFW, Takhli RTAFB, Thailand, December 1972

One of the early batch of 474th TFW arrivals at Takhli for *Constant Guard V* in September 1972, this aircraft (depicted here with Mk 82SE low-drag bombs) was the sixth F-111A to be lost during the deployment. After bombing Hanoi docks Capt Bob Sponeybarger and 1Lt Bill Wilson were hit by AAA over Hanoi on 22 December 1972. All 474th TFW aircraft were coded 'NA' after the adoption of wing-level maintenance on 1 April 1972.

6

F-111A 67-0078 of the 429th TFS/474th TFW, Takhli RTAFB, Thailand, September 1972

This aircraft was the first loss of the *Constant Guard* deployment on 28/29 September 1972 – the first night of the resumed bombing of North Vietnam and the very day that the F-111s returned to Takhli after a break of almost four years. *Combat Lancer* veteran Maj William Coltman and 1Lt Robert Brett successfully attacked their target, but the aircraft then vanished without trace. It was the second 'Roadrunner' F-111A to depart Takhli that evening, heading for Laos and a target near Yen Bai, in North Vietnam. Forty minutes into the mission, while the jet was flying over extremely uneven karst terrain, radio communication with the crew ceased after a slight change of course to avoid severe local storms that were reported in the area. It was assumed that the F-111 might have been hit by fragments from its own Mk 84 bombs, or that its TFR, faced with heavy rain, initiated a sudden 2g pull-up that would have exposed the aircraft to AAA.

7

F-111A 67-0098 of the 430th TFS/474th TFW, Takhli RTAFB, Thailand, October 1972

Representative of the third phase of the *Constant Guard* deployment, which involved the 430th TFS, this aircraft survived a mid-air collision as 'Igloo 50' during a formation position change on a Pathfinder mission on 17 February 1973. It met its end on 8 October 1982 when a faulty electrical connection interfered with the flight controls and the aircraft inverted 300 ft above the runway. Col Ernest Coleman managed to regain control sufficiently to eject with 1Lt Scott Springer, but both men sustained severe spinal injuries when the escape capsule's impact attenuation bags failed to inflate in time for a safe landing.

8

F-111A 67-0081 of the 429th TFS/474th TFW, Korat RTAFB, Thailand, May 1975

This aircraft arrived at Takhli in May 1973 as a replacement *Constant Guard V* combatant, and it transferred to Korat with the 347th TFW for continuation missions over Laos and Cambodia (the jet flew missions during the SS *Mayaguez* incident) until late June 1975. 67-0081 ended its career with the 366th TFW in June 1991.

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9

F-111F 70-2386 of the 493rd TFS/48th TFW, RAF Lakenheath, England, April 1986

As spare aircraft in the flight of F-111Fs targeting the Sidi Bilal terrorist training camp, 'Jewel 64' was armed with four GBU-10C/B LGBs and a PAVE Tack targeting pod. It saw far more direct action during Operation *Desert Storm*, completing its flying history in January 1996.

10

F-111F 73-0707 of the 494th TFS/48th TFW, RAF Lakenheath, England, April 1986

Delivered to the USAF on 26 February 1974, '707' spent most of its operational life at RAF Lakenheath. In Operation *El Dorado Canyon* it was the fourth (spare) aircraft in a flight that hit Tripoli airport with Mk 82 AIR bombs, destroying several Libyan aircraft. On retirement the F-111 had completed 5550.6 flying hours.

11

F-111F 71-0889 of the 493rd TFS/48th TFW, RAF Lakenheath, England, April 1986

This aircraft was part of the third cell of F-111Fs attacking the Bab al-Azizia compound with GBU-10C/Bs. It also flew numerous *Desert Storm* missions, after which the jet passed through the *Pacer Strike* upgrade programme and served with the 524th FS at Cannon AFB until its retirement in July 1996.

12

EF-111A 67-0052 of the 42nd ECS/66th ECW, RAF Upper Heyford, England, April 1986

This was one of six Ravens providing ECM support for *El Dorado Canyon*. In 1987 it was nicknamed *Cherry Bomb* (after an EB-66 that had served with the 42nd Tactical Electronic Warfare Squadron in the 1960s) as part of a commemorative aircraft naming programme at Upper Heyford. Service with the 429th ECS/366th TFW followed, and the jet completed its career at Cannon AFB with the 27th FW, serving until 1998 – 67-0052 had commenced its service as an F-111A with the 428th TFS in 1967.

13

F-111F 70-2387 of the 493rd TFS/48th TFW, RAF Lakenheath, England, April 1986

'Lujac' was the second cell of F-111Fs that targeted Tripoli airport with Mk 82 AIR bombs. Flown by Lt Col David White and WSO Capt Tom Himes, '387' also made the successful 'Deep Throat' attack on the Al Taji command bunker on 28 February using a GBU-28 Paveway III weapon. Although a 494th TFS aircraft, it was allotted to the 'Freedom' AMU, with its red fin tip and wheel hubs overpainted in yellow. It had no pinstripes on the nose-gear doors and the 494th patch was still on its right fuselage side, with *493rd AMU* painted underneath to show who looked after the aircraft. Post-war it was reallocated to the 495th TFS, receiving a green fin cap, and then the 27th FW. It had completed almost 6000 flight hours by the time of its retirement in December 1995.

14

F-111F 70-2391 of the 495th TFS/48th TFW(P), Taif, Saudi Arabia, January-February 1991

As the first aircraft to drop a GBU-28 'Deep Throat' bomb in action, '391 released its 5000-lb weapon on the Al Taji command bunker on 27 February 1991, although the target was destroyed by a second bomb from 70-2387 (see previous profile). This F-111F completed 46 missions in *Desert Storm* and went on to join the 27th FW, where it served as the 523rd FS flagship.

15

F-111F 71-0884 492nd TFS, 48th TFW(P), Taif, Saudi Arabia, January-February 1991

This aircraft, nicknamed *The Executioner* pre-war, was among the first to depart for Saudi Arabia on 25 August 1990. It accumulated an extensive list of destroyed tanks and aircraft shelters. Modified in the *Pacer Strike* programme, it then wore the yellow tail-band of Cannon AFB's 524th FS until mid-1996.

16

F-111F 70-2370 of the 494th TFS/48th TFW(P), Taif, Saudi Arabia, January-February 1991

Displaying an impressive total of 28 missions and HAS kills, '370' was maintained by the 'Justice' AMU and carried the nickname *Black Velvet* on its left nose-gear door. The reproduction of the World War 2 North Africa Campaign Ribbon, carried proudly by all 48th TFW F-111Fs on their tails, was prompted partly by the USAF's failure to recognise the unit's achievements in *El Dorado Canyon* with a general award. Transferred to the 524th FS/27th FW after *Desert Storm*, 70-2370 was written off after a weapons bay fire during a training flight in July 1994 at Nellis AFB.

17

F-111F 72-1450 of the 494th TFS/48th TFW(P), Taif, Saudi Arabia, January-February 1991

Transferred from the 493rd TFS for the 494th's *Desert Storm* deployment, 72-1450 is depicted here carrying GBU-15 glide-bombs beneath the wings and an AXQ-14 data-link pod under the rear fuselage. It received *Pacer Strike* updates during its service with the 524th FS and was subsequently stored for potential sale to Australia.

18

EF-111A 66-0030 of the 390th ECS/48th TFW(P), Taif, Saudi Arabia, January-February 1991

One of the six 42nd ECS 'jammers' for the *El Dorado Canyon* mission, this Raven also participated in *Desert Storm* with the 390th ECS from Mountain Home AFB ('MO' codes). Four years earlier, during its time at Upper Heyford in 1987, it acquired the nickname *Mild and Bitter Homebrew* as a salute to a similarly-named B-26B Marauder that served with the 322nd Bomb

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Group, Eighth Air Force, during World War 2. 66-0030 concluded its USAF service with the 429th ECS at Cannon AFB.

19

EF-111A 66-0056 of the 42nd ECS/66th ECW/48th TFW(P), Taif, Saudi Arabia, January-February 1991

66-0056 was the 23rd EF-111A conversion, being delivered to Upper Heyford's 42nd ECS on 3 April 1984. In June 1987 it acquired the nickname *Babyjam*, although this was painted over before the jet deployed to Saudi Arabia in August 1990. 66-0056 deployed to Incirlik on 17 January 1991 for *Proven Force*. Also operating from Taif and Dhahran, '056' achieved an impressive record of combat missions (another 14 were chalked up beneath the EWO's cockpit) and it returned to Upper Heyford as *Jam Master*. A year later, on 2 April 1992, the aircraft crashed inverted into a factory car park at Barton Hartshorn, near Buckingham, after suffering an engine fire. Capts. Jeff Coombe and Dave Gevenish ejected safely, and both men flew many more Raven sorties as part of Operations *Northern* and *Southern Watch*.

20

F-111E 68-0036 of the 55th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, February 1991

This aircraft's 32 mission scores in the squadron's blue identity colour were later standardised in tan. Armed with Mk 84 bombs for medium altitude attacks, the aircraft also carries an ALQ-131 ECM pod on a rear fuselage mount. A brief resumption of 20th TFW duties (begun on delivery in August 1970) upon its return from the war ended with retirement to AMARC on 16 December 1992.

21

F-111E 68-0014 of the 55th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, February 1991

Armed with a typical load of Mk 82 500-lb bombs, 68-0014 displays 24 mission symbols for attacks across a wide area of Iraq extending to Baghdad. This F-111E was delivered in November 1969 and retired in June 1992.

22

F-111E 68-0046 of the 77th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, March 1991

One CBU-87 or CBU-89 canister was carried per pylon, although Mk 82 AIRs would have been a more usual war load for this F-111E's 12 Operation *Proven Force* missions. Black national insignia were part of the general tone-down of TAC markings in the early 1980s. 68-0046 had completed 5290 flight hours by the time it was retired in August 1993.

23

F-111E 68-0026 of the 55th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, March 1991

Once known as *Hawkeye* in the 55th TFS (a name originating from the Iowa State football team in the pilot and crew-chief's home state), this F-111E displays 23 mission markings. It also carried the nickname *Excalibur* on its left nose-gear door while at Incirlik. It was one of several F-111Es that began its service use with the 442nd TFS/474th TFW, before transferring to Upper Heyford's 20th TFW in 1971.

24

F-111E 68-0029 of the 55th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, February 1991

Operation *Proven Force* mission scores were retained on return to Upper Heyford, although they were often repainted in tan. 68-0029's scoreboard is in the original yellow, recording 18 combat sorties. Twenty-seven Upper Heyford F-111Es returned from Incirlik with mission markings, although only 22 were officially assigned to the 7440th Wing (P) as some aircraft were exchanged or replaced to comply with maintenance requirements. In all, 34 Upper Heyford F-111Es and EF-111As were deployed.

25

F-111E 68-0049 of the 79th TFS/20th TFW, RAF Upper Heyford, England, July 1991

This aircraft was an exception to the usual sober F-111 colours. Initially nicknamed *Easy Rider* and then *The Grim Reaper* (in 1987-88), the jet was chosen as the 79th TFS/AMU flagship upon its return from Operation *Proven Force*, in which it flew 12 combat missions. Adorned with suitable tail markings, it represented the 79th TFS, nicknamed the 'Tigers', at the July 1991 NATO Tiger Meet, held at Upper Heyford. Subsequently transferred to the 77th TFS, the aircraft was decorated with red tail-codes and extravagant nose-art as *77th Gambler's Last Deal* when the final batch of 77th FS F-111Es left Upper Heyford for the USA in July 1993.

26

F-111E 68-0083 of the 79th TFS/20th TFW/7440th Wing (P), Incirlik, Turkey, February 1991

In another variation on *Proven Force* mission markings, this F-111E returned with 12 small Iraqi flag emblems to record its sorties from Incirlik. 68-0080 used similar markings, while 67-0121 had a red lorry 'kill' among its other bomb 'hash marks'. 68-0083 was AMP-modified, and it was reassigned to the 428th FS/27th FW in July 1993 to serve as a training aircraft until its retirement in 1995.

27

EF-111A 67-0042 of the 42nd ECS/20th TFW/7440th Wing (P), Incirlik, Turkey, March 1991

67-0042 was nicknamed *The Old Crow* after the long-established term for the operators of airborne electronic 'black magic'. Previously, it had been the *Spirit of Idaho* with the 366th TFW at Mountain Home, and it returned to that unit several months after Operation *Proven Force* had ended still bearing 32 mission markings. The jet had deployed to Incirlik on 12 February 1991, and when it flew back to Upper Heyford (as seen here) on

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9 March it still wore the 66th ECW patch, six mission markings (each one representing five sorties) and a 'milk bottle' symbol. 67-0042 was the last EF-111A to leave Upper Heyford on 7 August 1992, the jet then joining the other surviving EF-111As for a final tour at Cannon AFB with the 429nd ECS.

28

EF-111A 66-0013 of the 429th ECS/27th FW, detached to Incirlik, Turkey, and Dhahran, Saudi Arabia, 1994

This aircraft acquired nose-art with Vietnam War overtones, hence its nickname, *Yankee Air Pirate*. As an F-111A, it had received *Harvest Reaper* updates but remained with the 4527th Combat Crew Training Squadron preparing crews for service in Vietnam. In April 1969 66-0013 had survived a major engine fire. Although the oldest F-111A to be converted to Raven configuration, it was in fact the ninth airframe on the conversion line. The jet was initially used for systems evaluation purposes by the Tactical Air Warfare Center's 4485th Test Squadron, before finally being assigned to the 429th ECS (the re-designated 390th ECS) and provided with AMP updates. The latter included a five-channel AN/ARN-151(V) Navstar satellite navigation system with a disc antenna ahead of the windscreen. 66-0013 was one of the last operational Ravens, being finally flown to storage at AMARC in 1998 by Lt Col Doug Couture and Chief MSgt Greg Weigl.

29

EF-111A 66-0044 of the 429th ECS/27th FW, Dhahran, Saudi Arabia, 1995

A 474th TFW F-111A from 1968, this aircraft was converted into an EF-111A on the Raven conversion line in 1983. It subsequently served with the 390th ECS, with which it deployed to Saudi Arabia for Operation *Desert Storm*. Missions in support of *Provide Comfort*, *Southern Watch* and *Northern Watch* followed when the squadron became the 429th ECS. The aircraft then returned to Cannon AFB, where it was lost in an accident near the base on 17 June 1996. Capt James Wingo Jr and EWO Capt Donald R Watson ejected successfully.

30

RF-111C A8-143 of No 1 Sqn, 82 Wing RAAF, Tindal Air Base, Northern Territory, September 1999

One of the RF-111C conversions performed by RAAF Amberley's 3rd Aircraft Depot technicians in 1980, this long-ranging aircraft visited Bergstrom AFB, Texas, for the 1986 Reconnaissance Air Meet and *Red Flag* at Nellis AFB whilst assigned to No 6 Sqn. The RAAF acquired 15 ex-USAF F-111Gs in late 1992 ostensibly for future use when the C-models reached the end of their fatigue lives, but in reality the six best examples were flown as 'in-use' reserves alongside the F-111Cs in frontline use. When the F-111Gs were issued to No 6 Sqn, the four RF-111Cs previously assigned to the unit were transferred to No 1 Sqn. On 18 June 2006 Flg Off Peter Komar and his navigator, Flt Lt Luke Warner, successfully belly-landed A8-143 using runway arresting gear after a main-gear wheel separated on takeoff from Amberley. Despite fairly minor damage to the tough airframe, repairs were not authorised due to the type's impending phase-out.

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Front Cover
One of the most challenging missions of Operation Desert Storm in 1991 was flown on 27 January after Iraqi troops opened the taps on the oil terminal delivery pipes at Al Ahmadi, in Kuwait, causing a disastrous, spreading oil-spill that threatened to pollute the entire Persian Gulf. Four 48th TFW(P) F-111Fs armed with GBU-15(V)-2/B glide-bombs were sent to stem the flow by hitting the oil pumping stations. As these were situated close to residential areas, the extreme precision of the GBU was critical to the mission.

Maj Sammy Samson and his WSO Capt Steve Williams, in F-111F 72-1452 'Charger 35', were successful in launching a GBU-15 from 15,000 ft at supersonic speed towards the target. Capts Mike Russell and Brad Seipel, in F-111F 72-1446 'Charger 32', flying a race-track pattern more than 50 miles offshore, used the AN/AXQ-14 data-link pod mounted below their aircraft's rear fuselage to guide the weapon successfully to its target. Capt Seipel then directed a second GBU-15 in another supersonic run by 'Charger 35', hitting a second pump house three miles away that finally put an end to the lethal oil spillage (Cover artwork by Gareth Hector)

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